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Theory and Practice in Engineering Work

I—HOT WATER HEATING.

BY KONRAD MEIER.

The practical man, applying the rule of thumb and experience, is often heard to say that theory will not agree with practice. The college graduate will put this down to faulty application, quite as likely without being aware that his formula only covers an assumption and may not fit the conditions as they exist. Familiarity with both points of view and the habit of studying cause and effect eventually show the principal factors governing a case. When these are sized up correctly and taken into account, they will prove theory to be the safe and economical way of solving the greatly varying problems.

As a typical failure to recognize the true situation one still meets the belief that a certain amount of fluid requires a certain size of pipe to handle it, under given general conditions. Such a condition, for instance, is the working pressure at the steam boiler. Naturally it is the pressure, or the power behind the fluid, that governs delivery, but, as a matter of fact, a small and most variable portion of the working pressure is expended in creating the movement.

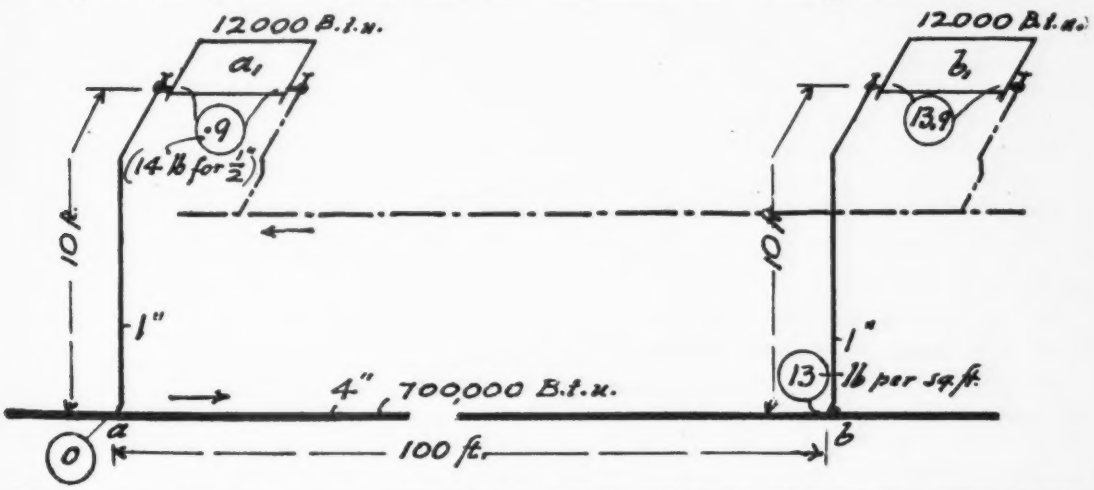


FIG. 1.—STEAM MAIN (5 LBS. PER SQUARE INCH) SHOWING HOW LOCAL CONDITIONS GOVERN FLOW IN PIPES.

The greater portion is stored energy. Most of this, again, as in the case of steam at several pounds pressure, may be delivered as heat and only a small part is actually used to overcome friction and local obstructions. The net pressure that remains, after deducting these resistances and any energy delivered as heat, is the power that produces the flow and determines the volume passing a given run of conduit between two junctions. In other words, the *local* conditions are the factors to be considered, since the net pressure available at any branch of a distributing system may vary within wide limits in one and the same plant. An example may serve best to demonstrate this point.

HOW LOCAL CONDITIONS GOVERN FLOW IN PIPES.

Fig. 1 shows a steam main carrying 700,000 B. T. U. per hour, under a working pressure of 5 lbs. per square inch, with two branches, each to deliver 12,000 B. T. U., of equal length and resistance, but 100 ft. apart. Sized by the approximation tables in general use, the main will figure 4-in. in diameter and the branches 1-in. each. The pressure loss from junction a to junction b will figure 13 lbs. per square foot (13/144 lbs. per square inch). From branch a to radiator a_1 it will be 0.9 lbs. and the same from b to b_1. Hence we have a drop of 13.9 lbs. from a to b_1, while from a to a_1 the difference is only 0.9 lbs. for the same volume passing. Branch a will therefore have 13.9 ÷ 0.09 = 15.5 times as much pressure available for moving the steam as branch b. This will have little effect, after warming up, where each radiator has a water seal and when delivery is governed mostly by condensing capacity, but with dry return mains or risers, the steam would pass through a and a_1 into b_1, running against condensation and possibly entering radiator b_1 from both ends, binding the air as well as holding up the water. A ½-in. branch at a would approximately cause the same pressure drop from a to a_1 as from a to b_1 and equalize the tendency of the steam to flow toward each radiator.

Under certain conditions, it would be proper to make the far branch 1¼-in. and the near one, ¾-in., which would have the same effect, but in many cases ½-in. would be better and could safely be used for branch a.

For a main with several branches between, decreasing in size, and for lower working pressures, the situation would not change materially. Similar examples for other fluids would demonstrate the point equally well.

SIMILAR RESULTS OBTAINED IN FORCED HOT WATER HEATING.

On a forced hot water system, for instance, the mains and branches are often sized simply on the basis of assumed velocities. The distances are usually longer and the extreme connections likely to be far apart. Fig. 2, shows a main carrying 400 gals. per minute, at 3.4 ft. velocity, which figures 7-in. diameter, with two equal branches 200 ft. apart, each delivering 4 gals. per minute through 1¼-in. pipe, at 0.88 ft. velocity per second. The loss of head in the main from a to b for 400 ft. (flow and return) with fittings, would run up to 3.14 ft. of water column. From a to a_1, and from b to b_1, it will be 0.34 ft. Radiator a_1 will, therefore, have a difference of 3.14 + 0.34 = 3.48 ft. of head available for moving the water, while radiator b_1 circulates under only 0.34 ft. Branch a, with ten times the pressure, will receive approximately three times the volume of water, unless throttled during operation or sized so as to consume equal head from a to a_1 as from a to b_1. A ¾-in. branch at a would bring about the desired result. This example shows a condition that is by no means extreme. Higher velocities in main pipes, which are often used, would result in still greater discrepancies.

SAME PRINCIPLE APPLIES IN AIR DUCTS.

While the delivery of heat is not necessarily proportional to the volume carried of water, steam or hot air, and deficiencies are always compensated to a greater or less extent, the volume itself must be considered as the expected result when handling air for ventilation. An example for air conduits would show again that the total resistance to the end of the near branch is liable to be much smaller than that through the far end of the line.

Of course, the total pressure drop from any junction to the atmosphere by way of the long or short branch is bound to equalize itself, *but not for the desired volume.*

The conduits should be sized so that the total resistance from a junction to the atmosphere will be the same for the stipulated capacity, either way, directly through a branch or through the main and a further branch.

It would seem self-evident that any distributing system ought to be equalized on this principle, but the means to do it have so far not been easily available. Now that they have been placed within the reach of those desiring to use them, it may be expected that their use may become quite general when their advantages are fully realized. Hence, it may be useful to consider separately some of the possibilities, not only of a theoretical nature, but for the practical handling of water, steam and air.

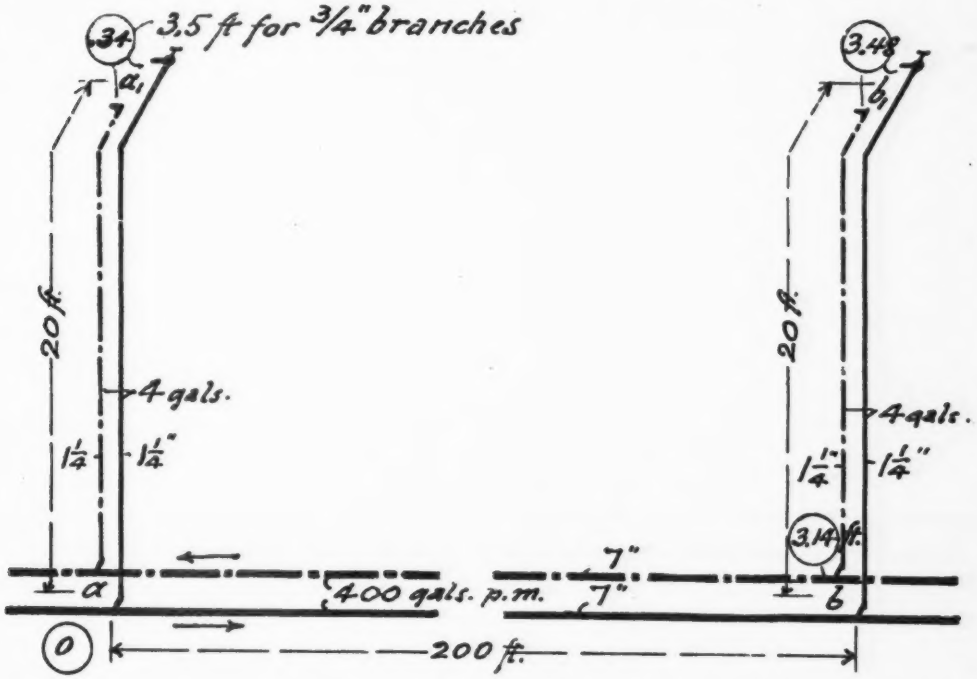


FIG. 2—FORCED HOT WATER MAINS ILLUSTRATING HOW FLOW IS GOVERNED BY LOCAL CONDITIONS.

Hot Water Heating.

A gravity system is self-regulating to an extent in that a smaller volume delivered by one branch, owing to excessive friction, will give up more heat per pound of water, increase the difference in weight and partially overcome the extra resistance. There are often, on the other hand, great differences in the height of water columns in one system and, at the same time, a great range of distances, so that those *local* conditions which govern the flow will differ still more than in the case with uniform power, as with steam or forced hot water. Approximation tables take into account the heights and distances in a general way, but cannot cover the local situations and other factors that may have material influence as, for instance, the method of piping.

The sizing of a pipe system by such tables is, therefore, most liable to fall wide of the true requirements and to favor some of the individual circuits at the expense of others. The former will naturally warm up first. In order to obtain heat in the latter ones, there must be an excess of heat elsewhere. The flow temperature, at which circulation becomes general and sufficient at all points, must accordingly be higher. This is always a handicap to a good and economical service, even though the faults become less noticeable after warming

up. It will lead to more or less overheating and reduces the range of general regulation.

When accurately proportioned so that resistances will balance the available heads, no branches can overtake the others and, consequently, there will be even circulation from the start, as soon as heat is generated. In practice, with reasonably careful calculation and execution of plans, circulation can be established throughout an extensive system at 80° F. flow temperature. This gives practically the full range of general regulation, assuring the best service and the greatest thermal efficiency of the plant as a whole. An evenly-balanced pipe system is also the best safeguard against freezing, which is most liable to occur when the fire is low and some of the less favored circuits have dropped out of circulation.

ADVANTAGES OF LARGE TEMPERATURE DROPS IN FLOW AND RETURN LINES.

It is well understood that gravity hot water apparatus can be proportioned to circulate at any range of temperature, within practical limits. A small difference assumed between flow and return makes it easier to balance, partly because there are also smaller differences in the capacities of commercial pipe sizes, due to the decreasing amount of heat delivered per pound of water. With 20° F. a 1-in. pipe will carry 10,000 B. T. U. per hour, while losing about 0.21 ft. of the effective or actual head available for every foot of length. With 40° F. difference, the same heat is carried at a loss of head figuring only 0.024 ft. per foot of run, or about one-ninth of the former. A ½-in. pipe will carry nearly as much at 40° F. (80% approx.) as a 1-in pipe at 20° F. range.

It will be apparent that small differences between flow and return whicih were formerly favored because they give more even circulation with less calculation, must involve considerably greater bulk of water which takes longer to reheat. With larger differences and smaller piping, on the other hand, the water contents can very well be reduced to a point where a hot water gravity plant will be fully as quick to respond as the average steam heating apparatus, with equal boiler capacity, while it loses nothing of its range of general regulation, when properly calculated.

The differences mentioned are by no means extreme. Gravity systems are in use with as little as 10° F. difference, but are generally cumbersome and slow to respond. In Germany, a range of 54° F. (30° C.) is not infrequently employed, though this cannot be said to be good practice, since the piping will figure undesirably small and adjustment becomes unavoidable. The temperature range should be chosen according to conditions and so that the system can be equalized *by friction,* not by throttling, without resorting to impracticable sizes. Experience will soon dictate the proper choice. Pipe of ½-in. diameter can be used successfully and, for short runs, in accessible but not exposed places, even ⅜-in. diameter, if the apparatus is thoroughly flushed out. This ought to be done in any event. Nor is there any reason why uneven sizes should not be used for flow and return or for any portion of an individual branch, if necessary to obtain the desired resistance or easement. A variety of means are available for securing any degree of accuracy in balancing, but it would lead too far to go into these.

SAVING IN FIRST COST OF PROPERLY DESIGNED SYSTEM.

Systematic calculation may thus effect considerable saving in first cost, not only in piping and insulation, but through omission of the secondary radiator valves for adjustment and the time of skilled men for adjustment. It has been shown in practice that any apparatus can be planned and executed with little trouble, without requiring subsequent throttling, and that the circulation is likely to be more perfect than that obtained by artificial devices. Adjustments are liable to be tampered with, while right sizes of pipe will stand. The smaller piping, moreover, will reduce the heat losses in transit to the rooms and may sometimes justify a reduction in boiler capacity, especially when a large water contents would otherwise require an extra allowance for reheating. The difference in first cost of a hot water system, as compared with a steam heating apparatus, can in this manner be reduced to a point where a

client will no longer hesitate between the two. In some cases, hot water will even turn out to be cheaper than a steam plant of the kind that would be acceptable.

The habit of scientific work will enable the designer to meet unusual situations for which artificial acceleration is often resorted to, by the simplest and surest means, that is, by gravity. This not only simplifies the plant, but retains the benefits of general regulation and moderate water temperature, which are lost more or less through the use of the schemes for accelerating or forcing.

It is possible, at the same time, to determine accurately where gravity systems will not pay and where forced circulation will become more advantageous. Considering these points, it seems worth while to go into hydraulics or the mechanical side of heating problems.

(To be continued)

Changing a Heating Plant from High to Low Pressure Steam

ALTERATIONS IN THE SYSTEM FOR THE SHOE AND LEATHER BANK BUILDING, NEW YORK.

By C. E. Daniell.

Because of the excessive wear on the hydraulic elevators in the Shoe and Leather Bank, an eleven-story office building on the southwest corner of Broadway and Chambers Street, New York, it was decided to install electric elevators rather than to repair the hydraulic machinery. This change made the use of high pressure steam unnecessary, so a low pressure, gravity-return system was decided upon.

After making a careful survey of the old heating system, it was found that the necessary changes could be made at a very small expense, as all the mains and risers of the old low pressure system were in good condition and of ample size to conform to good engineering practice. By changing to the low pressure system, the saving in the operating expense is evident, as the services of a licensed engineer are no longer required and the return feed pump may be discarded.

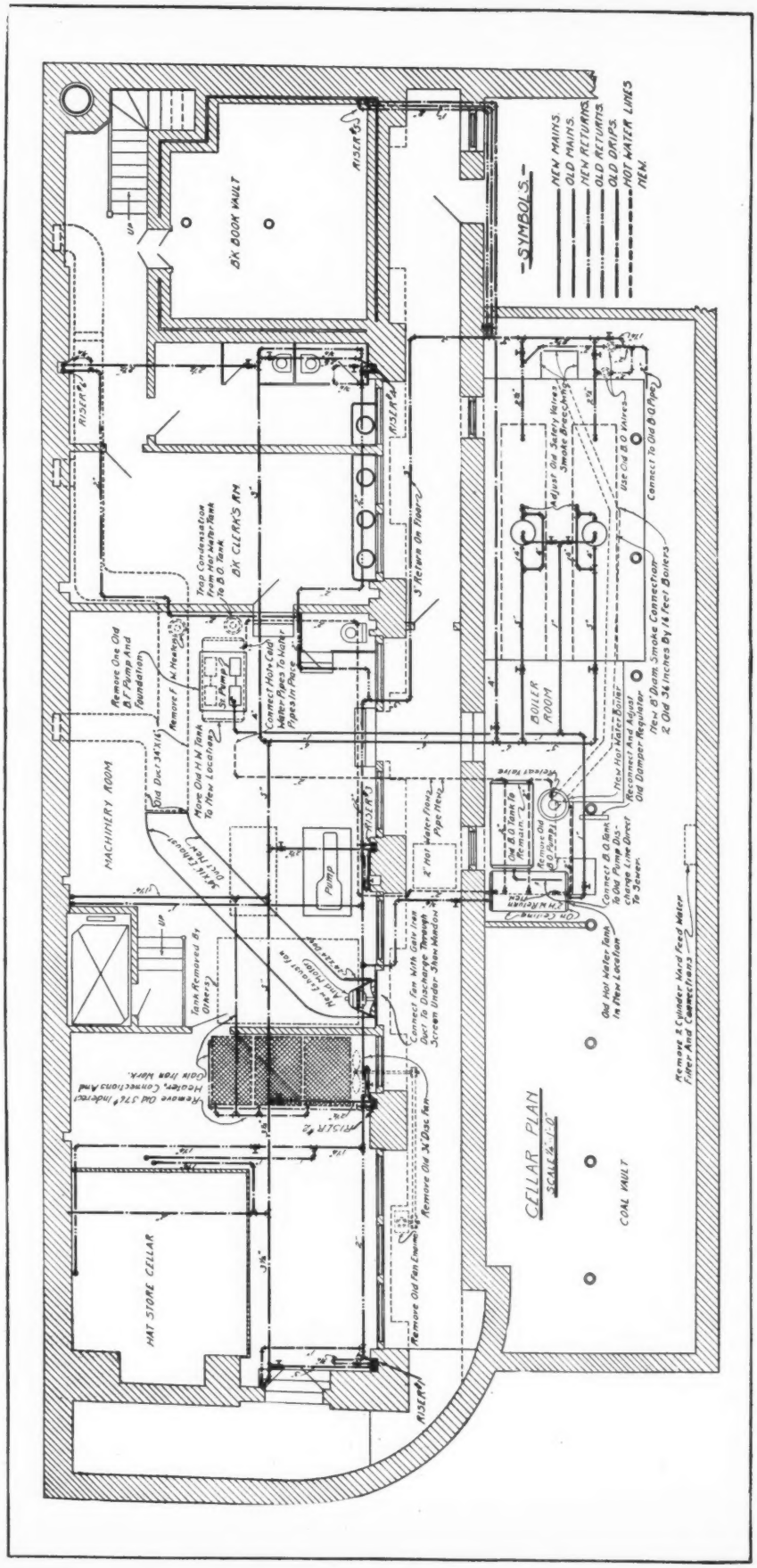
As all old pipe work that could be used was left in position, it was only necessary to change the boiler room and return mains and to remove all old apparatus and materials which was not to be used in the new system. In addition to these changes, the heating system for the bank floor was changed from a plenum to a direct-indirect system, supplemented by direct radiators, as shown on the bank floor plan. The basement radiators were shifted to conform with the changes in the show windows.

In connection with the hydraulic pumps in the basement, the following apparatus, which is shown on the sub-basement plan, was in use: two 36-in. x 16-in. boilers, with domes; two 6-in. x 4-in. x 6-in. duplex boiler feed pumps, either or both of which could be used as a house pump; one 4½-in. x 2¾-in. x 4-in. duplex blow off pump, one blow off tank, one filter, one feed water heater, one stack of indirect heaters of 576 sq. ft., with casing; a 36-in. disc fan, a 5 H. P. fan engine, one back pressure valve, one reducing valve and the necessary duct work for supplying heated air to the bank floor.

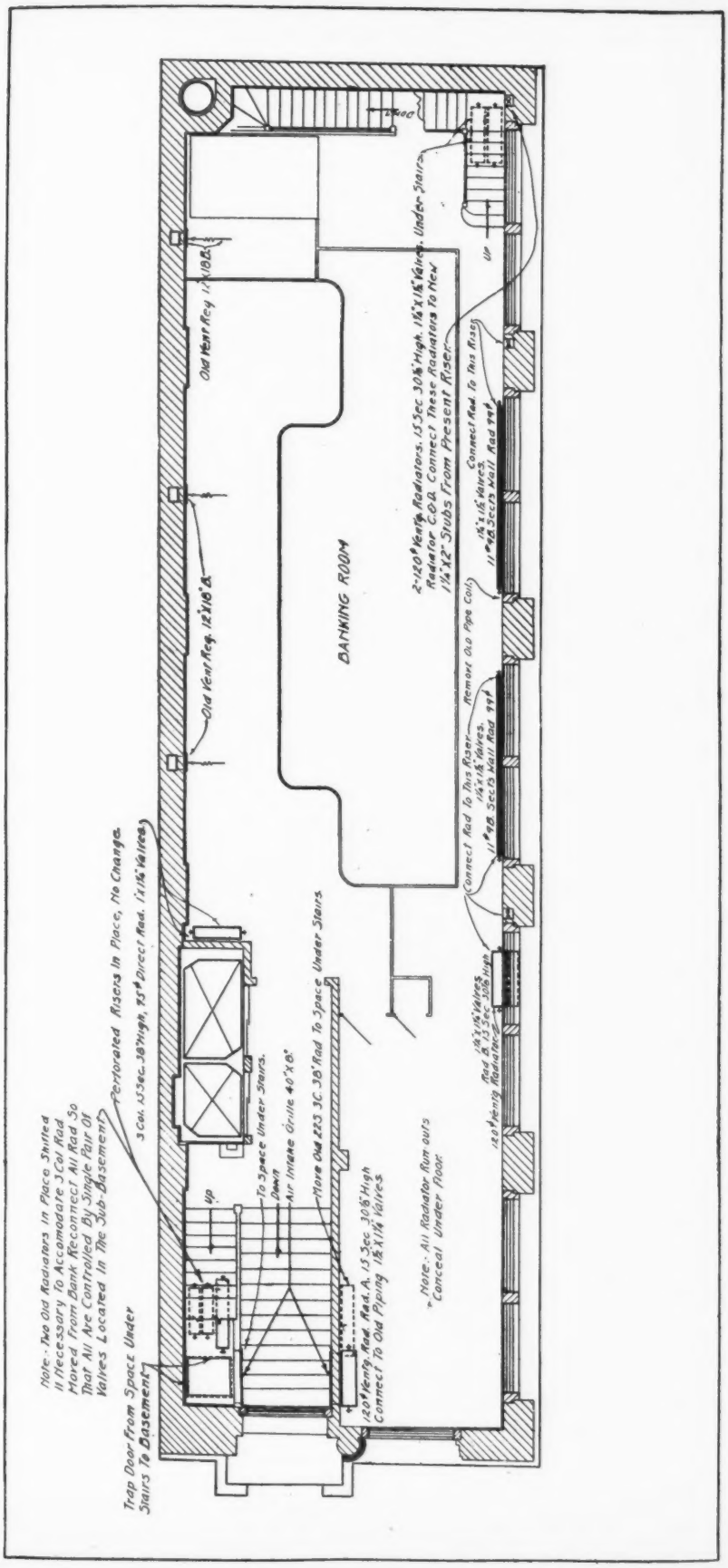
Of this apparatus, the blow off pump, one feed pump, the feed water heater and filter, the fan and engine, the back pressure valve and pressure reducing valve, as well as all high pressure steam mains, were removed, as they could be of no use with the new system. All apparatus that was removed went to the heating contractor in part payment for the necessary new apparatus and its installation.

RETAPPING OF BOILERS AVOIDED.

The boilers were left in their old setting, but it was found that the 4-in. tappings in the front sides of the domes, which were used to supply the high pressure system, were not large



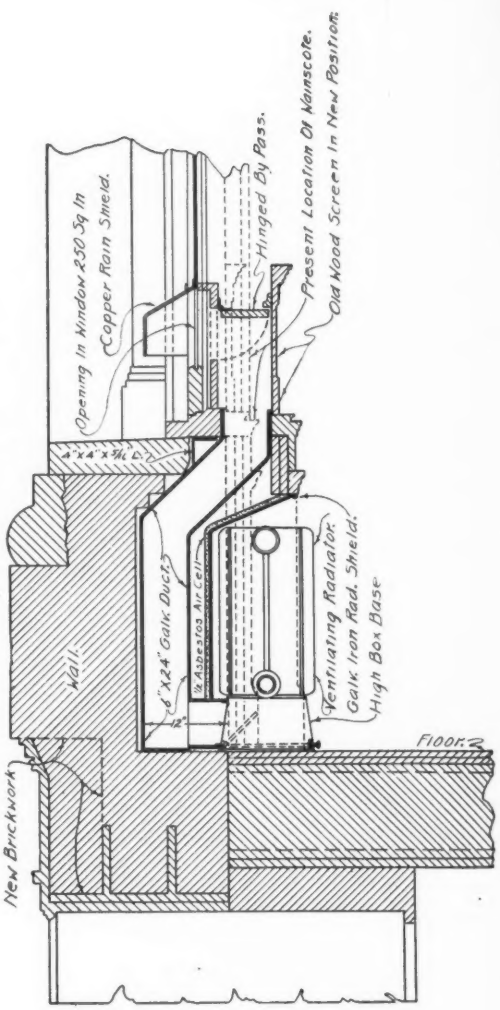
SUB-BASEMENT PLAN, SHOE AND LEATHER BANK, NEW YORK, SHOWING ALTERATIONS IN HEATING SYSTEM FROM HIGH TO LOW PRESSURE STEAM.


BANKING ROOM
Old Vent Reg. 12"x16"
Old Vent Reg. 16"x16"
2-120 Vent. Radiators, 15 Sec 30" High, 16"x15" Valves, Under Stairs. Radiator C.O.D. Connect These Radiators To New 1½"x2" Stubs From Present Riser
Connect Rad. To This Riser
1-18 Sec. 16" Wall Rad 99
Remove Old Pipe Coils
Connect Rad To This Riser
1-18 Sec. 16" Wall Rad 99
Ref. 16"x15" Valves 1-25 Sec 30" High Vent. Radiator
Perforated Risers In Place, No Change.
3 Col. 15 Sec. 38" High, 75 Direct Rad. 1"x16" Valves
Trap Door From Space Under Stairs To Basement
Note: Two Old Radiators In Place Shifted If Necessary To Accomodate 3 Col Rad Moved From Bank Reconnect All Rad So That All Are Controlled By Single Pair Of Valves Located In The Sub-Basement
To Space Under Stairs. Down
Air Intake Grille 40"x8"
Move Old 225 3C 38" Rad To Space Under Stairs
120 Vent. Rad. Rad. A. 15 Sec 30" High Connect To Old Piping 16"x16" Valves
Note: All Radiator Runouts Conceal Under Floor
Up
Up

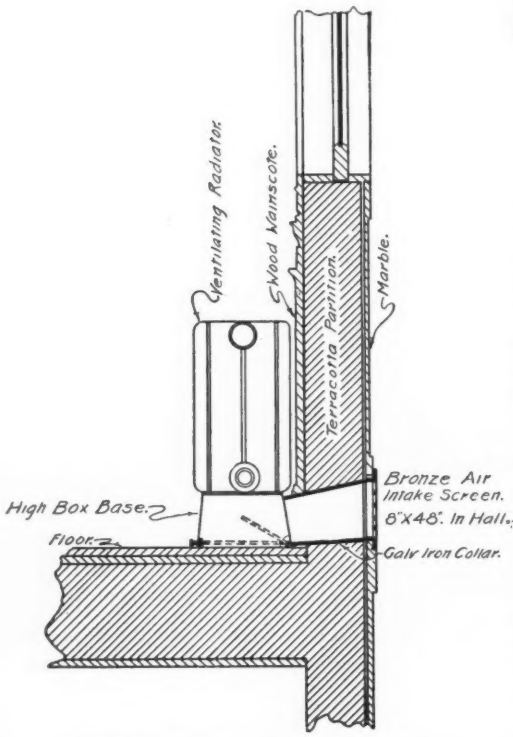
BANK FLOOR PLAN, SHOE AND LEATHER BANK, NEW YORK, SHOWING OLD AND NEW LOCATION AND ARRANGEMENT OF RADIATORS.

enough to supply low pressure steam to the heating system. Rather than retap the boilers for a 5-in. main, a 4-in. pipe was looped around each dome from the 5-in. main to the rear of the dome, where the blow off valve had originally been connected, the blow off valves being moved to a position back of this connection. From these loops, 5-in. mains supply a new 6-in. main which feeds the old 4-in. and 5-in. low pressure mains in the sub-basement. A new 3-in. return from the old 2-in. returns was connected to the boilers by two 2½-in. returns at the points where the old 2-in. blow offs entered the boilers, it being unnecessary to retap the boilers as they were originally tapped for 2½-in. The old 2-in. blow off piping and valves were used as before to connect to the old blow off tank.

As the old house pumps could not be used with the low pressure steam system, an electrically-driven Quimby pump was installed. One old house pump was left in position and so connected and valved that in case the electric pump breaks down, one boiler may be used to supply it with high pressure steam for pumping. The 1-in. steam main which supplies the house pump with high pressure steam in case of emergency is ordinarily used to supply low pressure steam to the old hot water heater. For supplying hot water during the summer a cast-iron hot water heater has been installed and connected to the hot water tank, as shown on the sub-basement plan.



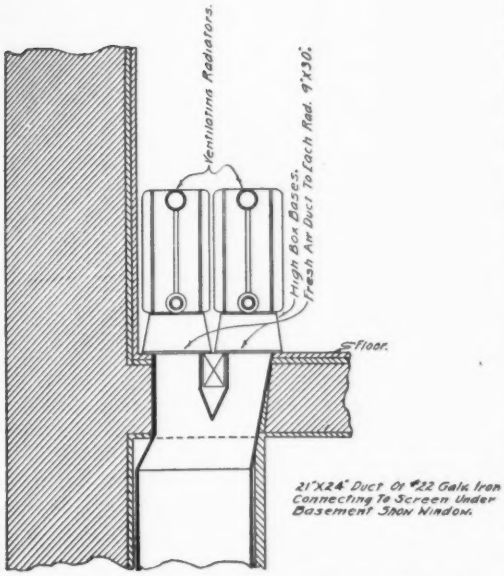
DETAIL OF RADIATOR B.



DETAIL OF RADIATOR A.

VENTILATION SYSTEM CHANGED FROM SUPPLY TO EXHAUST.

Because of the odor on the bank floor caused by the plenum heating system, this system was discarded and the duct work used to exhaust air from the bank room and to discharge it through a screen under one of the basement show windows. A 30-in. propeller type fan, with a 1½ H. P. variable speed motor, is used for exhausting the foul air at


Ventilating Radiators.
High Box Bases.
Fresh Air Duct To Each Rad. 9"x30".
Floor.
21"X24" Duct Of #22 Galv. Iron Connecting To Screen Under Basement Show Window.

DETAIL OF RADIATORS C AND D.

an approximate rate of 3,500 cu. ft. per minute. This gives three air changes per hour in the bank room.

ARRANGEMENT OF DIRECT-INDIRECT RADIATORS.

The arrangement of the four direct-indirect radiators, which are used to supply the heat to and ventilate the bank room, are very good examples of the flexibility of the direct-indirect system. These radiators have extra high bases of the aerial sanitary type, with fresh air intakes arranged as shown in the accompanying illustrations. The ducts supplying these radiators are designed to supply one-half the air that is exhausted by the exhaust fan. The fresh air intake to Radiator A is arranged in the usual way, with the intake coming through the wall directly into the high base. In the case of Radiators C and D, it was not possible to cut through the walls, as was done at Radiator A so the fresh air is supplied in by duct work which takes in the fresh air through an opening over a sub-basement window into the bottom of the high bases under the radiators.

At the point where Radiator B is located, it was not possible to cut through the walls or to bring the duct work through the floor below, so an entirely different scheme is used in this case. The woodwork around the window has been moved out 6 in. from the window sill and the brick work beneath the window furred out 12 in., to give space for a 6-in. x 42-in. air supply duct which is concealed in the wall behind the radiator. As may be seen from the illustration, this duct may be used either to supply fresh air to the radiator base from the supply duct or to circulate warm air through the radiator, it being only necessary to change the position of the damper in order to change the air supply.

The work was done under the direction of D. Everette Waide, architect, New York; and J. F. Musselman, consulting engineer, New York.

District Steam Heating with High Pressure Steam

By F. W. Ballard.

(*Read May 24, 1913, before the Ohio Society of Mechanical, Electrical and Steam Engineers.*)

District heating is at present being done to a very large extent with low pressure steam and in some plants by the forced circulation of hot water. However, it is the purpose of this paper to show that the advantages incident to low pressure steam heating from isolated plants will not be found when the attempt is made to extend the distribution of steam over a wide range of territory.

When the heating of small or moderate-sized factories is under consideration, where the buildings to be heated are within a radius of a few hundred feet from the power house, and where the size of the power plant is under, or at most not much in excess of 1,000 KW. capacity, then it is without question more economical to operate the power plant with simple non-condensing engines and use the exhaust steam for heating purposes. The heating plant should then be operated under a vacuum system and the back pressure on the engines maintained at practically that of the atmosphere. In such a plant, a charge for the heating

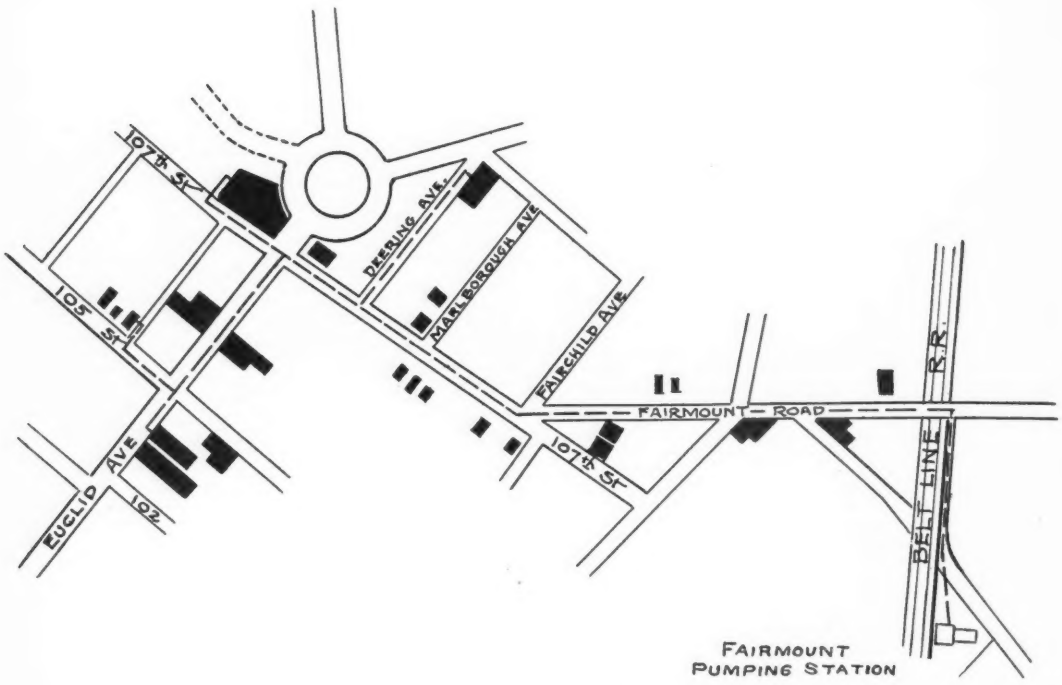


FIG. 1.—MAP OF CLEVELAND MUNICIPAL HEATING SYSTEM FOR 1912.

should be made to the departments served, and a corresponding credit given to the power plant of about 12c. per year per square foot of radiation. The cost of power in a plant of this kind can then be reduced to about 1.5c. per KW. hr. Similar results can, of course, also be obtained in isolated plants, such as those in-

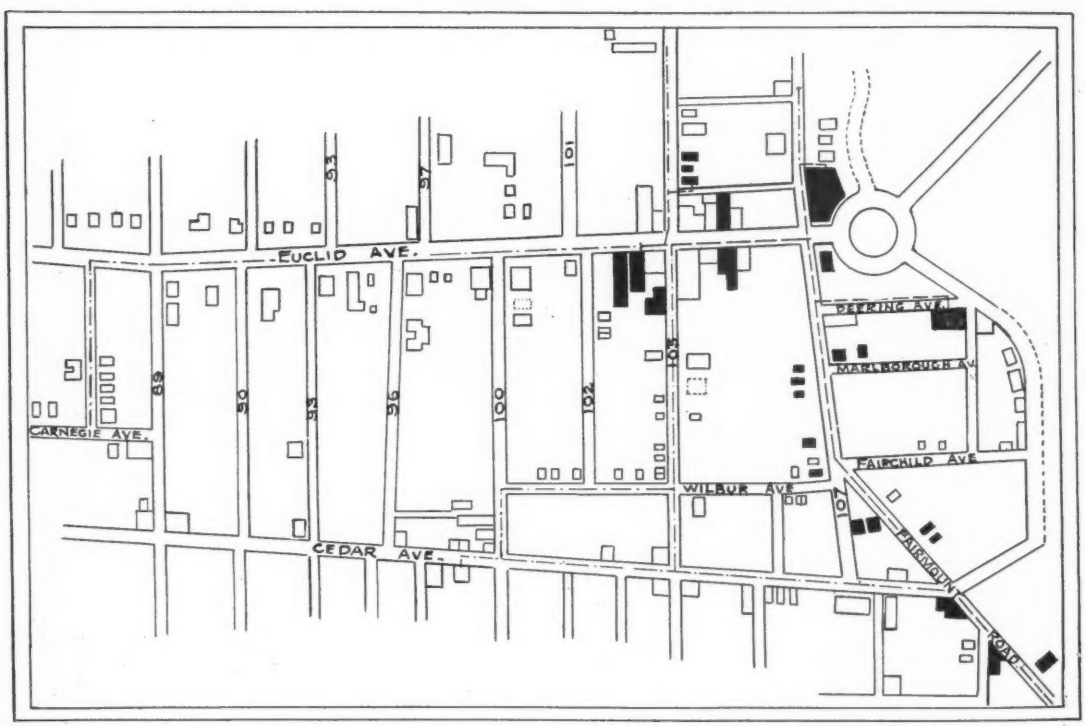


FIG. 2.—MAP OF CLEVELAND MUNICIPAL HEATING SYSTEM FOR 1913.

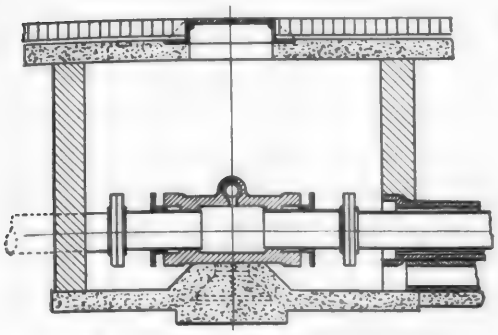


FIG. 3.—SECTION THROUGH TYPICAL MANHOLE.

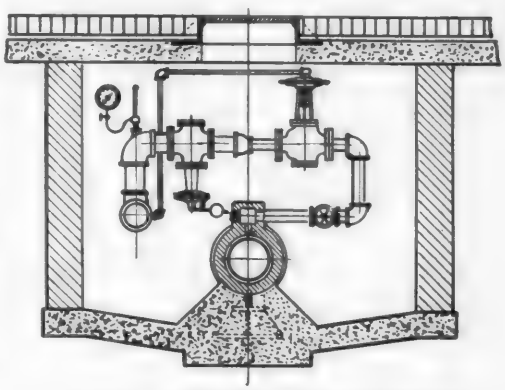


FIG. 4.—DETAIL OF MANHOLE.

stalled in large office buildings, hotels, etc.

It is unquestionably true, however, that in large central stations, operating large condensing steam turbines, and with modern highly-efficient equipment throughout, power can be generated for one-half cent per KW. hr. or even less. And in such installations, it is not good practice, nor is it economical, to try to run engines or turbines non-condensing for the purpose of securing exhaust steam for heating purposes or for any other purpose. We can only secure one-half or even less than one-half the power from a non-condensing engine or turbine which we could have secured from the same amount of steam; and this fact must not be lost sight of when considering the advantages of an exhaust steam low pressure heating system.

The greatest advantage, however, in the way of economy for a high pressure system is the much lower investment required by reason of the smaller size pipe necessary for the mains. Another advantage is the lower percentage of heat loss in the mains, due to the higher velocities and the smaller amount of surface in the underground mains.

With these ideas in mind we have undertaken in the City of Cleveland, the installation of a high pressure heating system. In this system we expect to distribute steam to greater distances and in larger quantities than would be financially possible with low pressure steam.

In Fig. 1 is shown a map of a portion of the district to be served. This map shows what has already been installed and what was in operation during the latter part of the season just closed.

In Fig. 2 is shown a map of the district which we expect to serve on the completion of the system contemplated. This we expect to have finished and in operation by the beginning of next season.

Table 1 gives the principal data in regard to this system.

This table gives the sizes and length of the mains in each of the different sections, the amount of steam passing through in horsepower, allowing 30 lbs. steam per hour per horsepower, the drop

TABLE I.—HIGH PRESSURE DISTRIBUTION SYSTEM.

1. Section of main.	2. Approx. length of section in feet.	3. H. P. of steam through main.	4. Diam. of main in inches.	5. Velocity of steam in ft. per min.	6. Drop in steam pressure, lbs.	7. Mean density lbs. steam per cu. ft.	8. Mean specific volume cu. ft per pound of steam.
Fairmount Rd. to Cedar Ave.	2,000	2,500	10	7,875	125-107, 18	0.29	3.42
Cedar Ave. to Euclid Ave...	2,000	2,000	10	7,100	107-94, 13	0.261	3.83
107th to 105th.	700	1,500	8	9,360	94-84, 10	0.236	4.24
105th to 96th..	1,500	1,000	8	7,000	84-74, 10	0.214	4.67
96th to end of line	2,000	500	6	6,800	74-57, 17	0.186	5.36

in steam pressure and the velocity in each section and also the mean density in pounds per cubic foot, together with its reciprocal which is mean specific volume or the cubic feet per pound of steam.

The initial pressure is 125 lbs. per square inch, and, under the conditions shown in the table, we would have about 57 lbs. pressure left at the end of the main.

DROP IN PRESSURE FORMULA.

The drop in pressure for each of the different sections is found by the following formula:

$$P = 0.0001321 \frac{W^2 L\left(1 + \frac{3.6}{d}\right)}{yd^5}$$

In this formula P = drop in pressure in pounds per square inch.

W = weight of steam in pounds per minute.

L = length of the pipe in feet.

y = mean density in pounds per cubic feet.

d = diameter of the pipe in inches.

The mechanical features of a high pressure system are interesting but not difficult. Since higher temperatures are involved, the question of heat insulation becomes more important than in a low pressure system. The expansion must be carefully taken care of and ample safeguards must be provided in the pressure reducing valves so that by no possibility can the high pressure find its way to the customers' radiators.

In Fig. 3 are shown the details of the manholes in which the expansion joints are installed. These are double slip joints installed every 400 ft. apart. Half

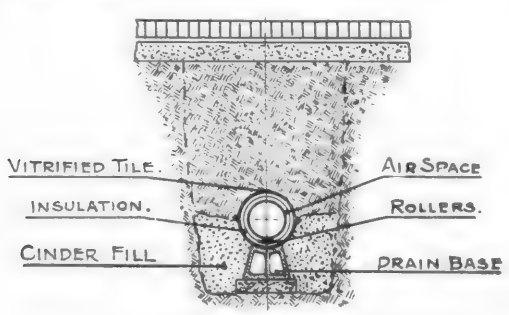


FIG. 5.—SECTION THROUGH TRENCH.

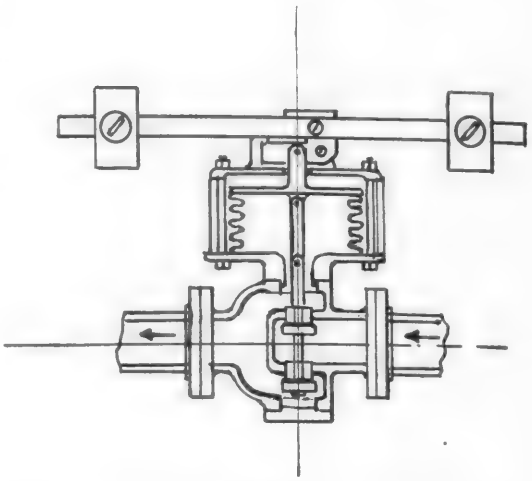


FIG. 6.—TYPE OF REGULATING VALVE USED.

way between these expansion joints the pipe is rigidly anchored to heavy concrete blocks and from the anchor to the expansion joint the pipe is carried on rollers in an absolutely straight line. Wherever there is a bend in the line in either a horizontal or vertical direction, the pipe is again anchored securely enough to take care of any thrust due to the unbalanced pressure.

In Fig. 4 are shown the details of manholes in which connections are made for steam to the service or low pressure mains. Sometimes these low pressure mains serve only one customer. Sometimes they serve several customers who may be grouped closely together. It will be noted that we install two reducing valves in series for these connections. The first one is set to regulate the pressure in the service main at 10 lbs. The second valve is set to operate at 15 lbs. and is intended to come into operation only on failure of the first valve. These second valves are tested regularly by the inspector who does so by holding the first valve open until the pressure in the service main builds up to 15 lbs. The second valves being open under normal conditions, the valve seats are always in good condition and the diaphragms do not wear out.

In Fig. 5 is shown a section of the trench illustrating the method of heat insulation and of draining any water in the soil away from the main.

In Fig. 6 is shown the details of the Sylphon regulating valve which we install in the basement for each individual customer. In addition to the means which this provides the customer for regulating his individual service, it also provides an additional protection against the high pressure finding its way to his radiators.

In Fig. 7, are shown the details of the installation on the customers' premises. This needs no explanation except that it might be mentioned that in some instances we install a regitherm in connection with the Sylphon regulating valve, for automatic regulation. This has been found in some cases to reduce the steam consumption by as much as 25 to 30% as well as relieving the customer of the inconvenience of hand regulation.

PIPING ECONOMY WITH HIGH PRESSURE STEAM.

In making a comparison of the size of pipe required for a high pressure system with the size required for a low pressure system one is confronted by the fact that the friction in the pipe varies inversely as the fifth power of the diameter and that provided a pipe of double the diameter is used the friction is thereby reduced 32 times. The drop in pressure is thus reduced so much by using a slightly larger pipe, that at first sight it might appear as a fallacy to argue that it would be more economical to use high pressure steam for the purpose of reducing the investment by reducing the size of pipe. However, when we take into consideration the very greatly increased cost of pipe and particularly the increased cost of valves and fittings when the size is doubled the saving in the investment acquires supreme importance.

For the purpose of this comparison, I have assumed that we have 15 lbs. per square inch pressure at the Fairmount Station, and that by allowing 10 lbs. drop, we would have 5 lbs. left at the end of the line, 8,200 ft. away. This would be necessary to give satisfactory and reliable service.

For computing the diameter of pipe necessary for each of the sections consid-

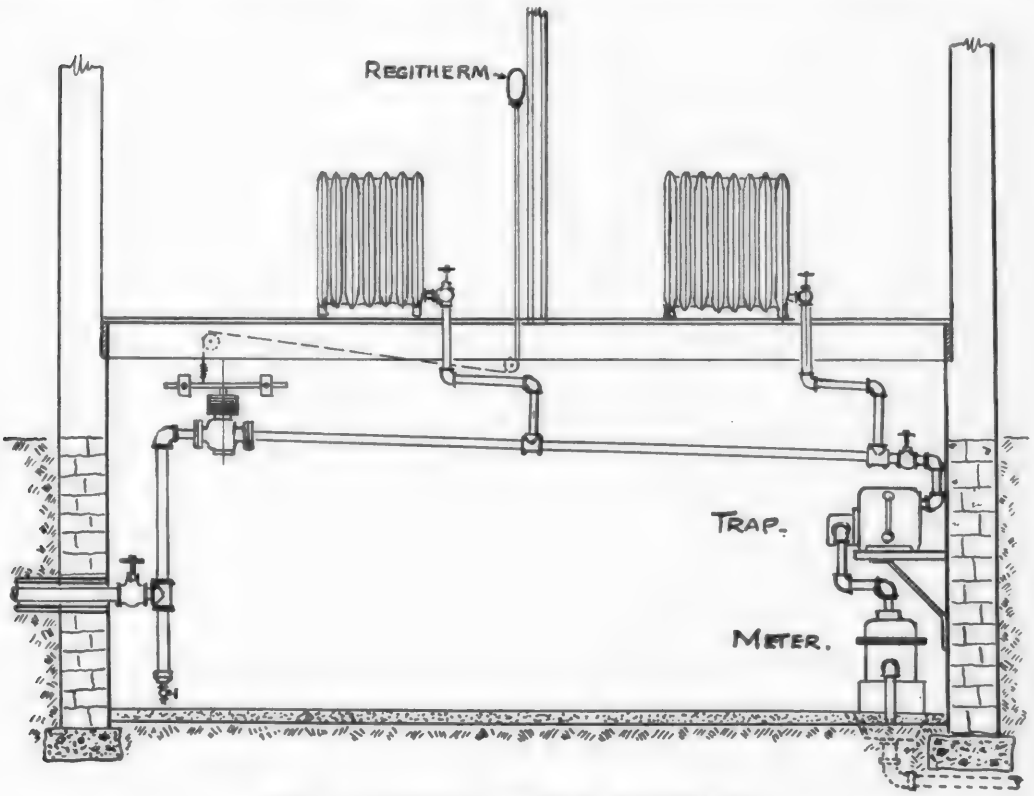


FIG. 7.—TYPICAL SERVICE EQUIPMENT.

ered above, I have used the following formula:

$$d = 0.2\sqrt[5]{\frac{W^2 L}{Py}}$$

This formula gives the sizes of pipe of the various sections of the distributing mains as shown in the following table (Table 2):

TABLE II.—LOW PRESSURE DISTRIBUTION SYSTEM.

1. Section of main.	2. Approx. length of section in feet.	3. H. P. of steam through main.	4. Diam. of main in inches.	5. Velocity of steam in ft. per min.	6. Drop in steam pressure, lbs.	7. Mean density lbs. steam per cu. ft.	8. Mean specific volume cu. ft per pound of steam.
Fairmount Rd. to Cedar Ave.	2,000	2,500	24	5,600	15-13, 2	0.074	14.03
Cedar Ave. to Euclid Ave...	2,000	2,000	22	5,770	13-11, 2	0.069	15.00
107th to 105th.	700	1,500	18	6,700	11-10, 1	0.064	15.79
105th to 96th..	1,500	1,000	18	4,730	10-8, 2	0.062	16.76
96th to end of line	2,000	500	14	4,500	8-5, 3	0.057	19.31

It is interesting to note that, although the pipe sizes are about 2½ times those for the high pressure mains, the velocity in the low pressure mains is very nearly as great. This is due to the difference in the density of the steam at the different pressures.

COMPARATIVE COST OF INSTALLATION.

The cost of installation for both the high and low pressure mains is shown by the following tables (Tables 3 and 4):

TABLE III.—COST OF HIGH PRESSURE MAINS.

4,000 ft. 10-in. pipe	$4,200
2,200 ft. 8-in. pipe	1,761
2,000 ft. 6-in. pipe	1,128
Valves and fittings	15,000
Pipe coverings and drain base	11,300
Excavation and back fill	10,560
Pipe fitting (labor)	4,300
Miscellaneous material, concrete, lumber, brick, etc	8,200
Repaving at $1.15 per ft	9,100
Total cost	$65,549

TABLE IV.—COST OF LOW PRESSURE MAINS.

4,000 ft. (22-in. and 24-in.) pipe	$15,300
2,200 ft. 18-in. pipe	6,630
2,000 ft. 14 in. pipe	4,600
Valves and fittings	51,000
Pipe covering and drain base	48,500
Excavation and back fill	12,900
Pipe fitting (labor)	6,000
Miscellaneous material, concrete, lumber, brick, etc.	12,400
Repaving at $1.25 per ft.	10,000
Total cost	$167,330

The cost of the mains for the low pressure distribution system are shown to be about 2½ times the cost of those for the high pressure distribution system and means an extra investment of something over $100,000. A conservative allowance for the fixed charges on this extra investment would be 10%, including interest, depreciation, taxes, etc. This means an annual charge of $10,000 against the low pressure system, over and above the fixed charges against the high pressure system.

Of course, the reason for the use of low pressure steam in heating systems is that the steam is first used for the generation of power and the exhaust steam is then used for heating purposes. However, when it is desired to transmit steam to considerable distances, it becomes necessary to carry at least 15 lbs. back pressure on the engines. This reduces their efficiency very greatly and adds to the importance of the question as to whether it might not be more economical to operate the power station condensing with maximum efficiency and use live steam for the heating requirements. It is very seldom, if ever, the case, that the heating requirements coincide with the power requirements, and the problem of regulating the load between condensing and non-condensing units so that the amount of exhaust steam would be just right is a difficult one. If this is not done then there is liable to be a loss due to exhaust steam going to waste, or, on the

other hand, having to supplement with live steam under low pressure conditions.

Leaving this factor out of consideration for the present, I would suggest a comparison between the two different methods as follows:

Suppose a boiler installation of 2,500 H. P. boiler capacity, such as we are installing at the Fairmount station. This would be capable of giving us 5,000 K. W. capacity of electrical power with suitable condensing equipment, requiring 15 lbs. of steam per K. W. hr. at the switchboard. This would include the operation of auxiliaries. The best we could expect with non-condensing engines or turbines would be 40 lbs. of steam per K. W. hr. We could then generate 1,800 K. W. with the 2,500 H. P. of steam and have about 80% of the heat left in the steam for heating purposes, but we would have to use low pressure steam with the necessarily larger mains. This would necessitate the losses due to the larger investment and the increased heat losses due to the greater amount of surface. We would secure 36% as much power with a consumption of 20% of the boiler capacity and have left 80% of the boiler capacity for the heating with the same consumption of coal and the same amount of steam produced.

We have thus secured 1,800 K. W. of power with an expenditure of 20% of the heat value of our steam. We have left 2,000 H. P. of steam to sell, having used 500 H. P. to generate power which would have required 900 H. P. of steam to produce, had we been running the electrical generating equipment separately and with highly efficient condensing apparatus. This analysis would show that the actual saving which has been accomplished is represented by the cost of producing 400 H. P. of steam.

The 400 H. P. of steam thus saved would have such a value as it would cost for its generation in a power station. We generally use for this purpose 10c. per 1,000 lbs. of steam. The period of time for which the saving should be allowed would be for the six months of the heating season, and, to be very conservative, we will assume that the saving goes on throughout the 24 hours of every day, although a 40% load factor on a central power station is generally considered very good. With these assumptions the saving amounts to $5,250 per year, but we have just seen that the fixed charges on the extra investment for the low pressure mains was $10,000. This one item alone costs nearly double what the saving would be from the use of exhaust steam.

There are, in addition, other items of great importance which also militate against the exhaust steam low pressure system for district heating. The non-condensing engines or turbines cannot be operated economically during the period of time when the exhaust steam is not required for heating. This makes an extra investment necessary for power generating machinery, the fixed charges on

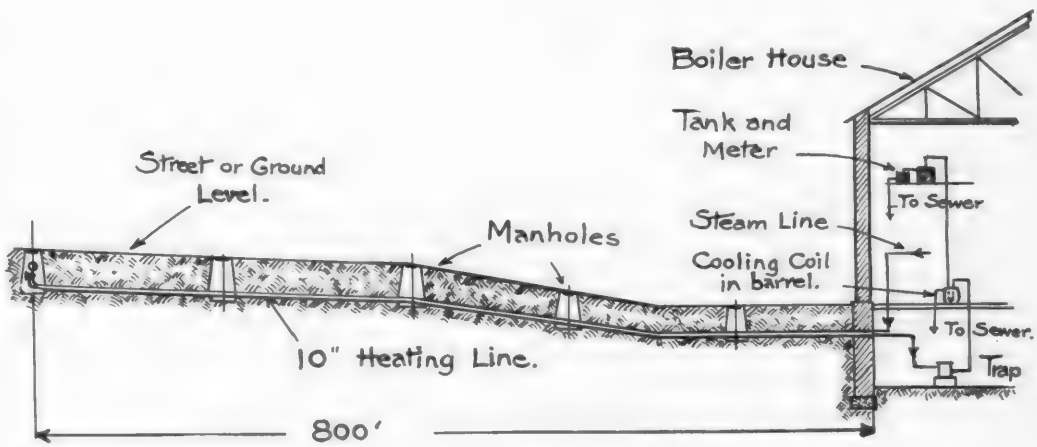


FIG 8.—SKETCH OF 10-IN. STEAM PIPE AND ARRANGEMENT OF TESTING APPARATUS.

which are quite considerable. Also the impossibility of having the requirements for heating coincide with the requirements for power from a central station means, to say the least, an extra investment in machinery.

There is also an advantage from the use of high pressure steam due to the great drop of pressure in the pipe. This does not represent a loss but gives a tendency to superheat and the customer is supplied with dry steam. In the low pressure exhaust steam system, there is a large percentage of moisture in the steam when it leaves the station, and to this is added the moisture due to the heat losses along the line.

Finally the losses in the pipe line are doubtless much greater in the low pressure system because of the much greater surface of the mains. Just what this amounts to, I have been as yet unable to determine. It certainly is not directly proportional to the square feet of surface and this to a certain extent would be offset by the greater loss per square foot of surface in the high pressure main due to the higher temperature. Such tests as we have been able to make would indicate that, although there is a greater loss from the larger main it is not in proportion to the square feet of surface, because of the effect of the surrounding earth which itself acts as a non-conductor.

In Fig. 8 is shown a diagram of the connections of a test on the pipe covering which was made last November. The first 800 ft. of the 10-in. pipe was dead ended and a pressure of 65 lbs. was maintained for about 10 days. An efficiency of the pipe covering was found amounting to 85% of the loss which would have been found with bare pipe. This I do not consider good enough. There is certainly an opportunity for great improvement in the methods at present obtainable for the protection of underground steam mains.

The question naturally arises that as a high pressure system is more economical than a low pressure system, what is the limit of pressure to which we would be justified in going?

The following table (Table 5) shows the data for 250 lbs. pressure through the first two sections of the 10-in. mains of our system.

In this table the drop in pressure in the two sections is shown to be about 2½ times that with the 125-lb. system and with only about 50% increase in the quantity of steam flowing through the mains. This is because the friction varies directly as the square of the weight of steam through the main. The density does not change very rapidly at this high pressure as the pressure increases. This, taking into consideration the difficulties connected with the generation and handling high pressures would seem to set the practical as well as the economical limit at from 200 to 250 lbs. pressure for a high pressure district heating system.

House Heating and Ventilating in Europe.

In the last 10 years the installation of hot-water and steam heating, and for large buildings the necessary ventilating facilities in conjunction therewith, has made enormous strides.

Quite recently most of the larger technical schools in Germany, notably those at Charlottenburg (Berlin), Hanover, and Danzig, have introduced regular courses in heating and ventilating engineering and give degrees in the subjects (corresponding to bachelor of science and doctor of science).

Most of the larger firms not only possess branch offices for the distribution of their manufactured product, but also a staff of experienced engineers to make the required installation.—From Vice Consul Ernest L. Ives, Magdeburg, Germany.

TABLE V.—250 LBS. PRESSURE DISTRIBUTION SYSTEM.

1. Section of main.	2. Approx. length of section in feet.	3. H. P. of steam through main.	4. Diam. of main in inches.	5. Velocity of steam in ft. per min.	6. Drop in steam pressure, lbs.	7. Mean density lbs. steam per cu. ft.	8. Mean specific volume cu. ft per pound of steam.
Fairmount Rd. to Cedar Ave.	2,000	3.770	10	6,200	250-200, 50	0.57	1.75
Cedar Ave. to Euclid Ave...	2,000	3.000	10	6,000	200-160, 40	0.47	2.14

National District Heating Association

FIFTH ANNUAL CONVENTION, INDIANAPOLIS, IND., MAY 27-29, 1913.

MARKED evidence of growth and virility was reflected in the fifth annual convention of the National District Heating Association which was held at the Claypool Hotel, Indianapolis, May 27-29. Outside of the net gain in membership the committee reports, such as those on meters and station records were unusually full, showing painstaking effort and will undoubtedly mark an important step in the guidance of the association towards standard and uniform practice in these matters.

The papers themselves were both numerous and timely and covered a variety of points that are among those just now uppermost in the minds of central station heating engineers. Finally, the machinery of the association, through the passage of amendments to the constitution, will enable the work to be carried forward more effectively while, at the same time, increasing the association's revenue to keep pace with its growing needs.

S. MORGAN BUSHNELL, CHICAGO.
New President, National District Heating Association.

An illustration of the desire of the association to cooperate with other engineering bodies was shown in the report of the educational committee giving the results of a conference held with a similar committee of the American Society of Heating and Ventilating Engineers. The first result of this conference is the compilation of a proposed code pertaining to important points in the installation of heating and ventilating plants (printed on another page of this issue). The committee was reappointed with a view of continuing this cooperation work.

Nearly 150 members and guests of the association were present in the Palm Room of the hotel when President R. D. De Wolf, of Rochester, N. Y., called the convention to order Tuesday morning, May 27. The president introduced former Mayor C. A. Bookwalter, of Indianapolis, who is again a nominee for this office. Mr. Bookwalter acquitted himself with honors in welcoming the association to Indianapolis. He stated that he had been in the central heating game himself until it became too strenuous for him. Secretary D. L. Gaskill responded to the address of welcome and called attention to the attractions of Indianapolis, which includes the largest hot water heating plant in the country.

Routine business followed, including the election of the following new members:

ACTIVE MEMBERS.

Lincoln Heat, Light & Power Co., Lincoln, Neb.

School of Mining, Kingston, Ont.

United Light & Power Co., San Francisco, Cal.

G. W. Byers, Atlantic City Electric Co., Atlantic City, N. J.

Warren Partridge, Penn Public Service Co., Clearfield, Pa.

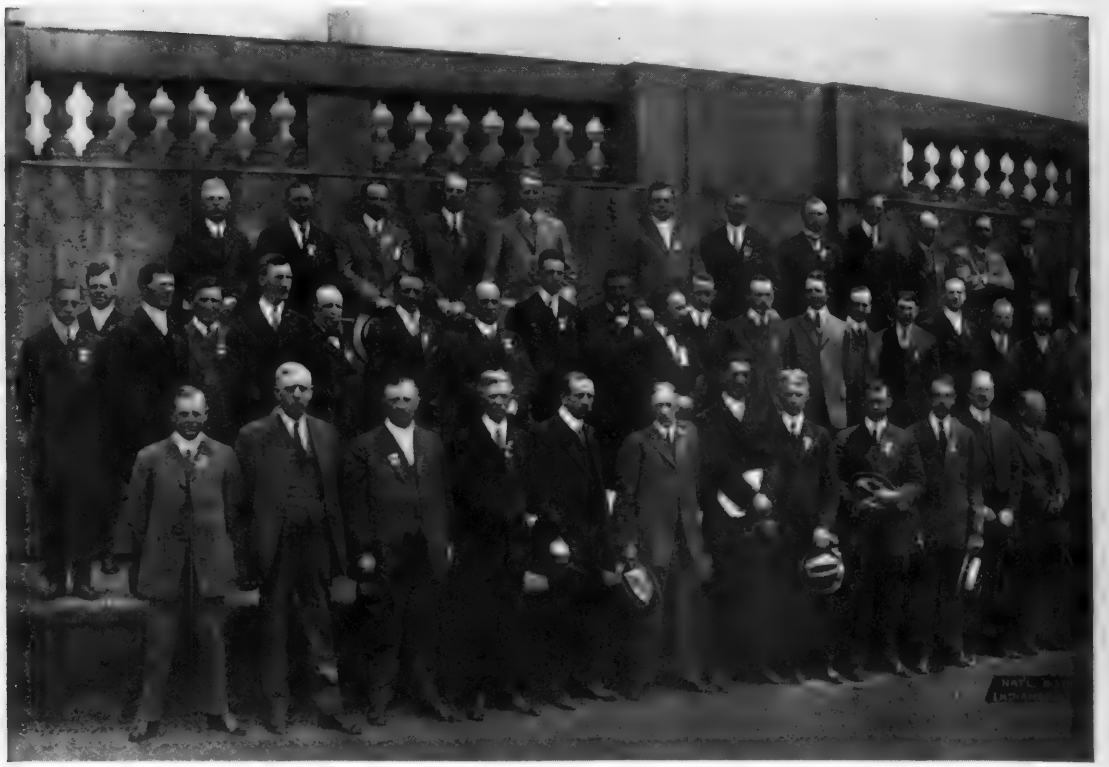
Theodore Weinshank, Indianapolis, Ind.

H. A. Woodsworth, Merchants Heat & Light Co., Indianapolis, Ind.

Younkman Bros., Tremont, O.

H. C. Heaton, Berwin, Ill.

Kokomo, Marion & Western Traction Co.,



CONVENTION PHOTOGRAPH, NATIONAL DISTRICT

(Indiana Railways & Light Co.), Kokomo, Ind.
Excelsior Springs Gas, Water & Electric Co., Excelsior Springs, Mo.
Wildwood Service Co. (R. B. Wiltsie, Mgr.) Toledo, O.
Chas. O. Myers, Billings, Mont.
J. J. Foley, Bryn Mawr College, Bryn Mawr, Pa.
Mineral Point Public Service Co., Mineral Point, Wis.
Citizens Mutual Heating Co., Terre Haute, Ind.
Indiana General Service Co., Elwood, Ind.
Peru Heating Co., Peru, Ind.

ASSOCIATES.

J. Robert Fortune, Murphy Iron Works, Detroit, Mich.
M. W. Kellogg, New York.
Logansport Radiator & Equipment Co., Logansport, Ind.
Virgil S. Brooks, Dayton, O.
B. F. Sturtevant Co., Boston, Mass.
Chas. E. Schreidt, Triumph Valve Co., Mansfield, O.
Hamilton & Scott, St. Thomas, Ont.
Babcock & Wilcox Co., Pittsburgh, Pa.
Terry Steam Turbine Co., Cleveland, O.
Detroit Lubricator Co., Detroit, Mich.

President DeWolf then read his address in which he stated that the association now includes in its ranks the bulk of those who are vitally interested in the central heating business.

"You have established a community of interest," he continued, "and an opportunity for cooperation which did not before exist; you have established a clearing house for the exchange of ideas and experiences, for the lack of which the heating companies have suffered in the past; and through this organization you can bring about a conformity of aim and purpose which will be of immeasurable benefit to all concerned.

"The apparent simplicity of laying a pipe in the ground and then going into the heating game has been too often made use of by the professional promoter; we have learned that it takes much more than a promoter, and generally more than a business man, to successfully design, install and operate a heating system, good engineering judgment and knowledge are essential.

"In this association you have a means of collecting and disseminating the

HEATING ASSOCIATION, INDIANAPOLIS, IND., MAY 27-29, 1913.

knowledge of this character which will be of great value, and I trust the time is soon coming when we, too, will have our own 'Question Box,' or similar organ to assist in this work. There is much to be done along these lines. Reliable data is needed covering the different plant operating conditions. The losses in transmission need to be studied more carefully. More economical methods of operation by the consumer should be devised, and the importance of such economies brought forcibly to the consumer's attention in such a way as to enlist his cooperation to the fullest extent. And I believe that a cheaper method of carrying heavy peak loads can be put in practical operation. These and other details readily suggest themselves, offering opportunities for much valuable work to be done by your committees.

"The question of rates opens up a large field for further development and co-operation, which is rendered more important by the increasing necessity of substituting the private plants by the central station companies.

SHOULD PROFIT BY EVOLUTION OF ELECTRIC RATE SYSTEMS.

"I believe the central station companies have now taken on the bulk of the small business available, so that load of this character will grow from now on about as the population of any given community increases. To increase their business at a greater rate it will, therefore, be necessary for the central station companies to be prepared to furnish a substitute for the private plants, giving heating service, as well as power. It is becoming more and more important that we be in a position to render this auxiliary service; in fact, it is often impossible to obtain the power business without the heating. We have seen the gradual evolution of our now more logical electric rate systems; let us profit by this experience, and put our rates for heating service on a logical basis, free from many of the criticisms now offered, and placing the central station companies on a firm basis for active growth.

"I want to call to your particular at-

tention the work of the Educational Committee, and the broad scope of its present and future activities. We have urgent need of the active cooperation of the heating contractors, and a realization on their part of our mutual responsibilities. We realize how the rendering of satisfactory service depends upon the character of the apparatus installed, and how much the customer's satisfaction with the heating apparatus installed depends upon that apparatus being of such character that the central station companies can render satisfactory service through it as a medium.

"We need more uniformity in our specifications covering heating installation, and more uniformity in our own rules regulating the customer's apparatus and his use of our service. Any influence which we can bring to bear upon the architect to interest him in the adoption of standard or uniform specifications covering heating apparatus, its installation and testing, will be of material benefit to ourselves and to our contractor friends.

"District heating is economically right, and with the increasing necessity for conserving our fuel resources, and with the growing demand for more smokeless cities, its importance, convenience and economy cannot fail to be recognized. In striving to attain these results, we must not forget that the cooperation of the consumer and a realization on his part of the importance of economical methods of operation, are essential."

The report of the executive committee consisted in the submitting of some proposed amenduents to the constitution, providing for three classes of membership with varying amounts of dues. The report was put over until the Wednesday session for further discussion before taking action.

Secretary-Treasurer D. L. Gaskill reported a balance of $319.95. He stated that the present membership stands at 168 active members and 61 associates, a net gain for the year. He also reported the loss in the Dayton, Ohio, flood and fire, of the bound proceedings for 1912, entailing a loss to the association of about $400. It is expected that the reprinted volume of the 1912 proceedings will be ready for delivery by September 1 next.

"The association," he concluded, "is in better shape than it has ever been."

NEW OFFICERS.

President De Wolf then appointed as a nominating committee W. A. Wolls, David S. Boyden and A. D. Spencer. This committee later presented the following ticket, which was unanimously elected at the Wednesday morning session:

President, S. Morgan Bushnell, Chicago.

First vice-president, E. Darrow, Indianapolis.

Second vice-president, H. M. Wetherell, Peoria, Ill.

Third vice-president, David S. Boyden, Boston.

Secretary-treasurer, D. L. Gaskill, Greenville, O.

Eecutive committee, C. F. Oehlman, Denver, Colo.; W. A. Wolls, Columbus, O., and R. D. DeWolf, Rochester, N. Y.

COMMITTEE REPORTS.

Following the regular order of business committee reports were presented by the committee on meters, through S. Morgan Bushnell, chairman; by the educational committee, through E. Darrow, chairman; and by the committee on station records, through H. R. Wetherell, chairman.

The steam meter committee's report gave descriptions of a number of meters in commercial use, including the Hallwachs, the Gebhardt indicating steam meter and the St. John meter. The report then took up present defects in meters and care of meters, together with proper sizes to use directions for setting, including a typical routine of operation in a meter department.

On the subject of meter vs. flat rate basis for charging, the report stated, as a deduction from the data it presented, that the average saving in steam consumption on account of the meter basis of charging, as compared with the flat rate basis of charging, will run about 25%.

In the subsequent discussion of this report, the sentiment in favor of the meter basis for charging was widely expressed, the points being made that with flat rate service, consumers will not shut off their radiators when the rooms be-

come too warm, but will open their windows. Mr. Mason, of Hornell, presented some convincing statistics showing the savings that had been effected in Hornell through the substitution of a metered service for a flat rate service.

AFTERNOON SESSION, MAY 27.

Following the report of the membership committee, presented by A. C. Rogers, the report of the educational committee was presented by E. Darrow and is given on another page of this issue.

A. C. Rogers, of Toledo, then read a paper on "Hot Water Heating for Residence Districts," which included thirteen radiation formulas and constituted a comprehensive guide for good practice in this branch of heating work. An interesting point made by Mr. Rogers was one advocating a larger amount of radiation to be installed on the basis that no building is so extravagantly radiated that it is not able to show both results as to heating and economy in cost of operation.

N. M. Argabrite, of the Indiana General Service Co., Elmwood, Ind., then read a paper on "Possibilities of Hot Water Heating."

A pleasant incident of this session was the presentation of a gavel to President R. D. De Wolf by A. T. Arens of Jenkins Bros.

MORNING SESSION, MAY 28.

Many suggestions for the keeping of station records were contained in the report of the committee on this subject, read by W. R. Wetherell, chairman. The report was a compilation of up-to-date practice as observed in the best-operated plants and showed the notable efficiency that has been developed in this respect.

Norman G. Reinicker of the Edison Illuminating Co., Detroit, Mich., then read a paper on "Recent Improvements in Boiler Plant Design and Operation," which was supplemented by a written discussion from Dr. D. S. Jacobus, of the Babcock & Wilcox Co.

This was followed by a discussion by users on "The Use of Bleeder Turbines."

After the election of the new officers was announced, President-elect S. Morgan Bushnell was called upon to address the convention. Mr. Bushnell spoke of the trend of large engineering associations to divide up their organization as it is found more effective work can be done in this way. This, he stated, was an argument for the existence and continued development of the National District Heating Association as an independent body and he predicted a brilliant future for the organization.

The proposed amendments to the constitution, as submitted in the report of the executive committee, affecting the status of membership and changing the clauses regarding dues, were then taken up.

AMENDMENTS TO CONSTITUTION.

The amendments as passed provided for three classes of members: active, associate and honorary. The active members are divided into three classes. Class A is open to such corporations, firms and individuals as are engaged in the business of owning and operating district heating plants or systems, also consulting engineers not directly engaged in the manufacture or sale of equipment, apparatus, material and supplies used in heating plants or systems.

Class B of active membership takes in officers or employees of such concerns as are Class A members.

Class C is open to local heating contractors and such persons as are interested in the subject of heating and who are not engaged in the manufacture or sale of equipment, apparatus, material and supplies used in heating plants or systems. Members in this class are not entitled to vote or to hold elective office.

Associate membership is hereafter to be open to such persons, firms or corporations as are engaged in the manufacture and sale of any material, equipment or supplies used by heating plants and systems, and such contracting firms or corporations whose business is national in its scope; and publishers of trade journals. Associate members have all the rights and privileges of active members except the right to vote and hold elective office.

Honorary membership is to be held open to persons whose distinguished merit or ability in the field of heating or engineering the association may desire to recognize or honor.

The yearly dues of active members will hereafter be $10.00, while those of associate members are to be $5.00.

Reference to the loss sustained by the association through the destruction of its 1912 bound proceedings in the floods and fire at Dayton, O., led to the starting of a subscription fund by Charles R. Bishop, of the American District Heating Company, to reimburse the association for the loss.

Subscriptions were received in the order named from the following:

American District Steam Co.	$100.00
Secretary D. L. Gaskill	10.00
Central Station Steam Co.	20.00
D. S. Boyden	15.00
Michigan Pipe Co.	15.00
W. A. Wolls	5.00
L. D. West	5.00
H. R. Wetherell	5.00
O. C. Irwin	5.00
C. H. Spiehler	5.00
D. K. Mason	5.00
A. Wyckoff & Son Co.	15.00
E. B. Tyler	25 00
C. F. Oehlman	5.00
R. D. De Wolf	10.00
E. Darrow	10.00
H. A. Ruth	5.00
A. D. Spencer	....
Peru Heating Co.	5.00
H. W. Johns-Manville Co.	25.00
Puget Sound Light & Traction Co.	20.00
Armstrong Cork Co.	25 00
Ric-Wil Underground Pipe Covering Co	15.00
Westinghouse Electric & Mfg. Co.	10.00
Youngstown Heating Co.	5.00

AFTERNOON SESSION, MAY 28.

The Wednesday afternoon session was opened with a talk, illustrated by lantern slides, on underground pipe covering, given by W. H. Prentis, Jr., of the Armstrong Cork Co. The pictures included views of the Armstrong Cork Co.'s heat loss testing plant at Beaver Falls, Pa., where experiments have been conducted both on pipe coverings and on heat transmission through a great variety of building materials. The testing room itself is 20 ft. long, 6 ft. wide and 8 ft. high. Mr. Prentis stated that the results of these tests would shortly be published by the company for the benefit of engineers generally.

In the discussion of this subject, Theodore Weinshank told of a form of underground pipe construction he had adopted in one instance to prevent water leakage. It was a case of carrying a 4-in. high pressure steam line (100 lbs. pressure) through a marsh. After a number of trials, he said that he first covered the piping with two thicknesses of 85% magnesia covering, and then used extra heavy cast-iron soil pipe, with calked joints as a conduit for the steam line.

Following this discussion, G. E. Quinnan, of the Puget Sound Traction, Light & Power Co., Seattle, Wash., gave an interesting talk describing district heating conditions in Seattle and at other points on the Pacific coast. His talk proved a most interesting one in offering hints on operating conditions that were new to many present.

The concluding speaker at this session was Harold Almert, of the H. M. Byllesby Co., Chicago, who read an authoritative paper on "Appraisal of Heating Properties." This paper was considered so important that it was later voted to send copies of it, together with a paper by Secretary D. L. Gaskill on the same subject, to every central station plant in the United States and Canada.

MORNING SESSION, MAY 29.

Thursday morning's program took in Secretary D. L. Gaskill's paper on "Commission Control of Utilities," which was discussed together with Mr. Almert's paper on the same topic. Mr. Gaskill called special attention to the law recently enacted creating a utility commission in Indiana as being a model law of its kind.

Two other papers were read at this session, one on "Is District Heating Profitable to the Central Station," by C. J. Davidson, of Woodmansee & Davidson, Chicago, which showed where leaks in the way of economical operation often occurred preventing profitable results. Incidentally the author ranged himself on the side of the meter rate advocates for steam heating service. The other paper was on "Operating Economies in Heating Large Factory Buildings."

Before the convention adjourned, D. L. Boyden suggested that additional standing committees be appointed by the executive committee, one on underground construction to procure data on the design and service of the different types of insulation of this character and a standing committee on publicity. To get the sense of the convention on this proposition, President De Wolf called for an expression of opinion which resulted in a favorable vote by those present.

Mr. Darrow stated that the heating plants in the city were open for the inspection of those interested and they were invited to go through them during their stay. On motion of G. E. Chap-

man a resolution of thanks, passed standing, was adopted in appreciation of the many hospitalities extended by the Indianapolis members and for the generous and delightful program provided by the entertainment committee.

Members and Guests Present.

D. L. Gaskill, Greenville, O.
R. S. Graves, General Electric Co., Cincinnati, O.
E. Darrow, Merchants Heat and Light Co., Indianapolis.
C. Fred Klee, Merchants Heat and Light Co., Indianapolis.
Joseph K. Smith, Pittsburgh Piping and Equipment Co., Pittsburgh, Pa.
H. R. Wetherell, Central Illinois Light Co., Peoria, Ill.
R. D. DeWolf, Rochester Railway & Light Co., Rochester, N. Y.
A. C. Rogers, Toledo Railways & Light Co., Toledo, O.
K. H. Meyerbacher, Boonville Electric Light & Power Co., Boonville, Ind.
Paul D. Birdsall, Peoples Light & Heat Co., Indianapolis.
P. J. Wensley, Peoples Light & Heat Co., Indianapolis.
B. Christian, Merchants Heat & Light Co., Indianapolis.
Joseph H. Meyer, The V. D. Onderson Co., Detroit.
R. C. March, Public Service Co. of No. Illinois, Chicago.
O. C. Irwin, Berlin Public Service Co., Berlin, Wis.
C. F. Oehlmann, Denver Gas & E. L. Co., Denver, Colo.
W. H. Pearl, Illinois Electric Co., Chicago.
H. A. Woodworth, Merchants Heat and Light Co., Indianapolis, Ind.
D. S. Boyden, Edison Electric Illuminating Co., Boston.
E. M. Bendure, Economy Steam Heating and Electric Co., Sedalia, Mo.
G. E. Chapman, Public Service Co., Oak Park, Ill.
Frank K. Chew, The Metal Worker, New York.
A. H. Lamond, Michigan Power Co., Lansing, Mich.
M. O. Payne, The W. H. Schott Co., Chicago.
G. P. Smith, Westinghouse Electric & Mfg. Co., Indianapolis, Ind.
J. C. Silverthorn, Evansville Public Service Co., Evansville, Ind.
T. H. Endicott, Crocker-Wheeler Co., Indianapolis.
Robert Ilett, Valentia Heating Co., Toledo, O.
Geo. D. B. Van Tassell, Power Specialty Co., Chicago.
L. S. Shaw, Westinghouse Machine Co., Chicago.
W. J. Grambs, Puget Sound Traction, Light & Power Co., Seattle, Wash.
Douglas A. Brown, Cincinnati, O. (official reporter).
Sherman Allen, Citizens Gas, Electric and Heating Co., Mount Vernon, Ill.
R. E. Williams, Birmingham Railway, Light & Power Co., Birmingham, Ala.
F. L. Johnson, Columbus Railway & Light Co., Columbus, O.
O. H. Caldwell, Electrical World, New York.
E. B. Tyler, Tyler Underground Heating Systems, Pittsburgh, Pa.
G. E. Quinnan, Puget Sound Traction, Light & Power Co., Seattle, Wash.
A. L. Meiers, Indianapolis Light & Heating Co., Indianapolis, Ind.
J. T. Trombley, Central Heating Co., Detroit.
H. A. Ruth, Helena Costume Co. (Heat, Light & Power), London, Can.
Jas. C. Stott, Hamilton & Stott, St. Thomas, Can.
L. W. Egleston, American Radiator Co., Chicago.
John H. Roberts, American Radiator Co., Indianapolis.
N. M. Argabrite, Indiana General Serice Co., Elwood, Ind.
N. M. Simmons, Indiana General Service Co., Elwood, Ind.
J. H. Walker, Edison Illuminating Co., Detroit.
N. G. Reinicker, Edison Illuminating Co., Detroit.
A. D. Spencer, Edison Illuminating Co., Detroit.
John T. Kester, Noblesville Heat, Steam and Power Co., Noblesville, Ind.
Henry Meyer, Citizens Mutual Heating Co., Terre Haute, Ind.
Aug. Jacob, Edison Illuminating Co., Detroit.
C. E. Perry, Indianapolis Light Heat Co., Indianapolis.
Herbert F. Wills, Frankfort, Ind.
S. Morgan Bushnell, Illinois Maintenance Co., Chicago.
A. E. Bettis, Kansas City Heating Co., Kansas City, Mo.
L. T. Mason, Hornell Electric Co., Hornell, N. Y.
A. S. Armagnac, The Heating and Ventilating Magazine, New York.
Fred. L. Crane, Norristown Steam Heat Co., Norristown, Pa.
O. T. Carson, Domestic Engineering, Chicago.
T. Wilson, Power, New York.
O. H. Bathgate, Pittsburgh, Pa.
Theodore Weinshank, Warren, Webster & Co., Indianapolis.
D. K. Mason, National Tube Co., Pittsburgh, Pa.
J. C. Hornung, The W. H. Schott Co., Chicago.
F. W. Hornung, The W. H. Schott Co., Chicago.
L. D. West, Cleveland Electric Illuminating Co., Cleveland, O.
C. H. Spiehler, Dayton Power & Light Co., Dayton, O.
R. T. Kaighin, Cleveland Electric Illuminating Co., Cleveland, O.
Edward L. Wilder, Rochester Railway & Light Co., Rochester, N. Y.
John H. Devine, Miami Light Plant, Oxford, O.
H. A. Thrush, Peru Heating Co., Peru, Ind.
W. A. Wolls, Columbus Railway & Light Co., Columbus, O.
George D. Higgins, Murphy Power Co., Detroit.
J. B. Veerkamp, Armstrong Cork Co., Indianapolis.
R. M. Blackmore, Indiana Railway & Light Co., Kokomo, Ind.
Thos. Donohue, Indiana Lighting Co., Lafayette, Ind.
E. A. Wakeman, The Wilkes-Barre Co., Wilkes-Barre, Pa.
W. J. Maxwell, Indianapolis.
J. F. McDonnell, Dearborn Chemical Co., Indianapolis.
John T. Wurster, Iowa Railway & Light Co., Cedar Rapids.
E. F. Capron, Davis Construction Co., Chicago.
F. S. Richmond, Chicago.
F. C. Ludden, Mineral Point Public Service Co., Mineral Point, Wis.
H. F. Kaescher, Youngstown Heating Co., Youngstown, O.
Geo. H. Alexander, Frankfort Heating Co., Frankfort, Ind.
Geo. C. Daniels, Central Illinois Light Co., Peoria, Ill.
D. T. Wallace, The W. H. Schott Co., Chicago.
Chas. S. Clark, Practical Engineer, Chicago.
Harold Almert, H. M. Byllesby Co., Chicago.
A. P. Biggs, Central Heating Co., Detroit.
T. E. Turley, Indiana Power & Light Co., Kokomo, Ind.
E. E. Baker, Babcock & Wilcox Co., Chicago.
J. T. Lovett, Muncie Electric Light Co., Muncie, Ind.
Fred B. Orr, Illinois Maintenance Co., Chicago.
R. E. Hagenah, Springfield Gas & Electric Co., Springfield, Ill.
A. E. Duram, American District Steam Co., Chicago, Ill.
Geo. B. Thomas, Central Heating Co., Anderson, Ind.
T. H. Hays, Westinghouse Machine Co., Indianapolis.
J. D. Harris, Indianapolis.
W. H. Pearl, Indiana Electric Co., Indianapolis.

The Exhibitors.

Michigan Pipe Co., Bay City, Mich., had a notable exhibit, in charge of Henry B. Smith, Jr., showing a model service line with special Michigan wood boxes for enclosing elbows and tees. Another model showed a cross section of Michigan insulation arranged with crushed stone drainage and tile drains.

Ric-Wil Underground Pipe Covering Co., Cleveland, O., exhibited full sections of its one-pipe and two-pipe constructions for underground pipe insulation. H. W. De Bolt and J. H. Wilson were on hand in the interests of the company.

A. Wyckoff & Son Co., Elmira, N. Y., was represented by Henry Simpson, treasurer. The company's exhibit consisted of sections of improved cypress steam pipe casing and patented cypress steam pipe casing.

Hohmann & Maurer Division, Taylor Instrument Companies, Rochester, N. Y., showed types of its indicating and recording thermometers, mercury vacuum gauges, absolute pressure gauges, draft gauges, recording barometers, and aneroid barometers. L. B. Swift was in charge.

Detroit Lubricator Co., Detroit, Mich., showed types of its new packless radiator valves in globe, angle and corner types, also multipost graduated valves for vapor-vacuum heating systems; and pop valves for low pressure boilers. J. L. Fuller, of the company's engineering department, explained the line to those interested.

V. D. Anderson Co., Cleveland, O., showed one of its Model D steam traps, supplemented by an exhibit of various sized Anderson patent floats, which, it is emphasized are spun, not stamped, from Lake Superior copper, heavily reinforced and sealed by a special electric process.

General Electric Co., Schenectady, N. Y., exhibited new types of its recording, indicating and integrating steam flow meters and its steam, air and water meters. The exhibit also included samples of plugs and pipe reducers for use in connection with the meters. G. E. Woolley and I. B. Terry were in charge.

Armstrong Cork Co., Pittsburg, Pa., showed samples of its nonpareil high pressure pipe covering, running up to 36 in. in diameter, 3 in. thick, for steam lines, boilers, etc., including underground pipe conduits, also cork insulation for direct expansion ammonia and brine service. The company was represented by J. L. Patrick, J. W. Squier, H. W. Prentice an C. R. Lyle.

Cannelton Sewer Pipe Co., Cannelton, Ind., exhibited samples of its line of vitri-

CORNER OF CONVENTION HALL, SHOWING EXHIBIT OF H. W. JOHNS-MANVILLE CO.

fied fire clay conduit, for underground pipe insulation, with supporting tees, offset tees, sectional unions and split pipe. C. A. Clemens and H. M. Clemens explained the many advantages of this system to inquirers.

Central Station Steam Co., Detroit, Mich., had a working model of the Detroit condensation meter in operation, water being supplied by a small, electric-driven pump. The company also exhibited its line of expansion joints, diaphragm type, fitted up to show its operation; also the Detroit screen for protecting traps and meters. Those representing the company were J. V. Redfield, general manager, F. A. Green and W. R. Owen.

Jenkins Bros., New York, had an exhibit, as usual, of its line of radiator and

other valves and heating specialties. A. T. Arens, of the Chicago office, took care of the company's interests.

H. W. Johns-Manville Co., New York, had a full-sized model of the J-M sectional conduit for underground pipe insulation on view, in addition to a comprehensive exhibit of its steam pipe and boiler coverings, electrical conduits and asbestos roofings and packings. The company's representatives were C. E. Wehr, C. H. Staten, W. T. Bain and H. W. Johns.

Hardy Paint and Varnish Co., Toledo, O., showed a new product for the use of heating engineers, consisting of a high efficiency radiator enamel. It is claimed that with this enamel an efficiency of from 96 per cent. or 98 per cent. to 103 per cent. or 104 per cent. can be obtained. In support of these claims the company distributed literature containing a report of Prof. John R. Allen's tests at the University of Michigan in which he showed that while painting of radiators in most cases reduced their efficiency, the coating over the gold, aluminum or copper bronze with the right kind of radiator enamel brought the efficiency back to 100 per cent. The exhibit included radiators coated with the Hardy enamel. William H. Sur was in charge.

American District Steam Co., North Tonawanda, N. Y., displayed models of its underground steam main construction and types of fittings in brass; also its Simplex condensation meter and Atmospheric specialties. The company had a delegation present headed by Charles R. Bishop, general manager, and including Robert Hall, treasurer; H. C. Kimbaugh, Byron T. Gifford, C. A. Gillham, A. E. Duram, R. C. Holley and W. H. Wells.

The Entertainment.

An automobile trip was provided for the ladies on the afternoon of the opening day, the destination being the Indianapolis Country Club where the party alighted and partook of the club's hospitality.

In the evening a happy time was spent by all at the Hume-Mausur roof garden, the entertainment including a dance, buffet lunch and cabaret. President R. D. DeWolf headed the grand march, the line also including President-elect and Mrs. S. Morgan Bushnell. The festivities passed along smoothly until the orchestra played "Here Comes the Bride," which was the signal for a rush on the bride of the convention who luckily made her escape not an instant too soon.

Theatre parties occupied the second day, including one for the ladies in the afternoon and a box party for all in the evening at the commodious Murat Theatre, where "The Fortune Hunter" was on the boards. Several dinner parties preceded the evening's entertainment, the hosts including Mr. and Mrs. Theodore Weinshank who had as their guests representatives of the trade press.

Many stayed over to see the 500-mile motor race on the Indianapolis Speedway on Memorial Day, the event attracting a huge crowd and giving Indianapolis the appearance of a vast carnival city.

The following ladies were present:

THE LADIES.

Mrs. D. L. Gaskill, Greenville, O.
Miss Helen Gaskill, Greenville, O.
Mrs. W. H. Pearl, Indianapolis, Ind.
Mrs. A. C. Rogers, Toledo, O.
Mrs. J. L. Patrick, Indianapolis.
Mrs. E. Darrow, Indianapolis.
Mrs. Jos. H. Meyer, Detroit, Mich.
Mrs. G. E. Chapman, Oak Park, Ill.
Mrs. J. L. Fuller, Detroit, Mich.
Mrs. S. Morgan Bushnell, Chicago.
Mrs. Henry Simpson, Elmira, N. Y.
Miss May Fisher, Indianapolis.
Mrs. C. Fred Klee, Indianapolis.
Mrs. R. E. Woolley, Schenectady, N. Y.
Mrs. Theodore Weinshank, Indianapolis.
Miss Anna Weinshank, Indianapolis.
Mrs. John T. Kester, Noblesville, Ind.
Miss Lenore Kester, Noblesville, Ind.
Mrs. T. H. Endicott, Indianapolis.

On the entertainment committee were Edward L. McKee, president; E. Darrow (chairman) and B. D. Christian, of the Merchants' Heat & Light Co.; C. C. Perry, president, and Thomas Wynne, secretary, of the Indianapolis Light and Heat Co.; J. Harris, general manager of the People's Light and Heat Co.; J. L. Patrick, Armstrong Cork Co.; F. Nealis, Westinghouse Electric & Mfg. Co.; Richard Ferrel, General Electric Co.; L. S. Shaw, Westinghouse Machine Co.; C. Weir, H. W. Johns-Manville Co.; Charles Shotwell, Fairbanks, Morse & Co.; Thomas Endicott, Crocker-Wheeler Co.; Gordon Varney, president, Danville Electric Co.; John Kester, general manager, Noblesville Light and Heat Co.; R. C. Steuve, Allis-Chalmers Co.; and J. Kamps, Platt Iron Works Co.

"Twin-Stack News," the house organ of the Merchants' Heat and Light Co., was devoted to matters pertaining to the association. In addition to publishing the official programme, the souvenir issue contained a "Brief History of the National District Heating Association," by H. A. Woodworth and an article on "Public Utilities Companies—Their Construction, Financing and Management," by Joseph H. Brewer, vice president and general manager of the American Public Utilities Co.

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A. S. ARMAGNAC.....*President*
GUSTAVE PETERSEN.....*Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager

European Representative:
W. G. HOLLINWORTH, 304 High Holborn, London, W. C.

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NOTHING more interesting has transpired, certainly in recent years, in the advance of mechanical ventilation than the appointment of a Ventilation Commission by the New York Association for Improving the Condition of the Poor, acting under the terms of a $50,000 bequest made to the association for that purpose by the late Mrs. Elizabeth Milbank Anderson. We say mechanical ventilation because, although the commission intends to take up every phase of the problem, it is reasonable to suppose that its efforts will eventually be concentrated upon experiments with, and possibly developments of, mechanical means for maintaining the purity and freshness of indoor air. While the personnel of the commission, as given elsewhere in this issue, shows a predominance of medical men and physicists, the presence of at least two representatives of the engineering profession is assurance that the technical features of the problem will be adequately presented and that the investigation may be expected to start with the recognition of certain fundamental principles, one of which is the inadequacy of so-called natural ventilation systems to secure by themselves the desired ends.

For many years it has been the expressed wish of the heating engineers' society that opportunity might be afforded for conducting experiments on a sufficiently extended scale to establish once for all the basis for correct ventilating methods. The item of cost has heretofore been an insurmountable obstacle, but now it would seem that the two essentials of sufficient funds and a body of impartial investigators have at last been secured.

THE arrival of another convention season has already established the fact that general business conditions are not in the least affecting the customary large attendances and sustained interest of such gatherings. On the contrary, in the case of at least one representative body, the National District Heating Association, which met last month in Indianapolis, the attendance figures for members were the largest in the history of the organization. In addition, the discussions showed that trade conditions were not assuming unusual prominence in the calculations for the future, interest being centered in the solution of problems directly connected with the business. One feature of growing importance in this nection is the activity of public utility commissions in extending their supervision over central heating plants. The matter of rates, for instance, involving appraisals of the heating companies' properties, is rapidly becoming a determining factor in the success or failure of such enterprises and two timely papers on this topic practically marked the keynote of the convention.

THE CONSULTING ENGINEER

"The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

17—Varying Sizes of Pipes in Hot Water Work.

QUESTION: Can you give me the benefit of your advice in connection with the construction of a hot water system of heating, with forced circulation? The system is laid out with a single main serving different buildings, the longest circuit being 1,800 ft. out and back. At the far end of the circuit, where the branch mains enter the different buildings, they are graduated in some instances from 2 in. to 3 in.; also in one of the buildings they are reduced from 3 in. to 2 in. and then increased from 2 in. to 2½ in., forming a choke. Can you tell me what advantage there is in this method of connection? There are 3,800 sq. ft. of radiation on the end of the line served by the 3-in. pipe. An indoor temperature of 60° F. is required. The water in extreme weather is 200° F. outboard and 178° F. returning, while the friction head is 10 lbs. or 24 ft.

ANSWER.—The chokes referred to serve no purpose except to reduce the capacity of the mains at the points installed, in order to make some of the other circuits receive a greater proportion of water. The sudden change in velocity caused by changing the pipe sizes from 2 in. to 2½ in. or from 3 in. to 2 in. only increases the resistance and it would be better practice to distribute the unnecessary resistance by reducing the size of the main to that building. Such a procedure would also reduce the cost.

This method of reducing the main and return and cutting connections across requires more or less adjustment, as the head across the main is less as the distance from the plant increases. A drop of 10 lbs. is given or 34 ft. head, while the distance is about 1,800 ft. out and back to the pump. The average drop per 100 ft. would be $24 \div 18$, or 133 ft. head per 100 ft. This drop will vary somewhat as the main reduces in size. (The drop in head per 100 ft. is all that is given in order to make comparisons.)

A 3-in. main gives 1.47 ft. head drop per 100 ft. for 3 ft. per second, which is over 10 per cent. more than the average. The total drop is given as 22°, and it is possible the net drop in the coils will not be over 20°. Assuming a 3-in. main for this group would give a much greater discharge than where the 2-in. chokes are introduced, the discharge of the 3-in. main, under the conditions named, would be about 572 lbs. per minute. Then $572 \times 60 \times 20 = 6{,}864{,}000$ B.T.U. per hour, which, it is assumed, the 3,800 sq. ft. of surface actually gives up in order to heat the buildings satisfactorily. If it does not heat satisfactorily, the trouble will be shown. Coil surface should give up at least 1.7 B.T.U. per square foot per hour per degree difference.

The average temperature given is 178° F. and 200° F., or 189° F., say, 190° F., and with the room 60°, the difference would be 130° F. With the rooms at 70° it would be 120° F. $3{,}800 \times 1.7 \times 120 = 7{,}752{,}000$ B.T.U. per hour for 70° F. is the amount of heat that should be given up under the conditions named and possibly more will be obtained, but this is a minimum. $3{,}800 \times 1.7 \times 130 = 8{,}362{,}000$ B.T.U. per hour is the amount of heat that should be given up when the room is heated to 60° F. This shows that the surface is inefficient to the extent of $7{,}752{,}000 - 6{,}864{,}000 = 888{,}000$ B.T.U. for 70° F. and $8{,}362{,}000 - 6{,}864{,}000 = 1{,}498{,}000$ B.T.U. for 60° F. $888 \div 6{,}864 = 13\%$ for 70° F., and $1{,}459 \div 6{,}864 = 22\%$ for 60° F., so that a properly designed hot water system on the average temperature would require 13 per cent. less surface for 70° and 22 per cent. less surface for 60°.

This is a favorite mistake the engineer makes in reducing the pumping capacity and increasing the heating surface. For this particular job the head should be at least doubled or increased to 75 ft. and the mains and heating surface could then be reduced, decreasing the first cost of installation by that amount without materially increasing the operating expense.

With this particular arrangement of mains, the chokes would be quite troublesome in adjusting the circuits and the higher velocities would increase the losses therefrom without any gain. It would also be bad practice to place these at the end of the run, as seemingly has been done,

because if the lines are choked more than is necessary, the circuits nearer the pump would have to be throttled to a greater extent to balance the job, thus throwing extra resistance into all the circuits.

There is no advantage to be gained in running a large main and then reducing it two or three sizes, as the resistance might be better applied in using a smaller main throughout. All friction head available should be utilized for the velocity of the water and the mains sized so that the different sections will receive their proper share with a minimum of throttling.

Legal Decisions

Central Heating Company May Require Installation of Thermostat.

A heating company adopted a rule requiring the installation of thermostats in buildings which it heated, to be paid for and maintained by the consumer. It discontinued service to a consumer who refused to install a thermostat. The consumer sought to enjoin the company from disconnecting its pipes. There was no season contract with the heating company, and it appeared that the Railroad Commission was to be appealed to as to whether a thermostat should be put in. It was held that the company's rule was reasonable and, in the circumstances, the heating company could not be enjoined. The cost of putting in a thermostat nowhere appeared, nor the time required to install it. There could be no presumption, in the face of common knowledge on the subject, that the cost would be great or the time necessary for installation would be so long as to materially interfere with either the comfort or the health of the occupants of the plaintiff's house.—Walbridge vs. Berlin Public Service Co., Wisconsin Supreme Court.

Responsibility for Delay.

The contractors for the plumbing, heating, draining and gas fitting in an apartment house were intervening petitioners in a suit for a mechanic's lien. The owner's principal contention was that some amount should be awarded for damages caused by delay. The contract did not fix any time for the completion of the work, therefore the law implies that it was to be performed within a reasonable time. There was evidence tending to show that the contractors were delayed by the carpenter contractors and that changes were made in the specifications by the architects which caused delay. The architects issued a final certificate without making any deductions for delay, and the superintending architect testified that any delay which occurred was not chargeable to any of the contractors. The claim was allowed.—Republic Mfg. Co. vs. Strackbein, 163 Ill. App. 49.

Substantial Performance of Contract.

Action was brought to recover for labor performed and materials furnished in installing a steam heating plant, under the terms of a written contract. The contract price was $750. During the final installation of the plant the plaintiff was unable to procure the services of union workmen, and, at the suggestion of the defendant, a third party was employed to finish the work, and entered into a contract with the plaintiff to do it for $49. The contract was fully performed. The court found that the plaintiff had in good faith complied with the terms of the contract in all material and substantial particulars, and was entitled to recover the contract price less the expense of installing certain radiation. Judgment for $682.40 was affirmed on appeal.—Krumholz vs. Tobias, 167 Ill. App. 553.

Toledo Rail-Light Company's New Schedule of Rates for Hot Water Heating.

As directed by the Ohio Public Service Commission, whose report was published in THE HEATING AND VENTILATING MAGAZINE for May, the Toledo Railways & Light Company has filed with the commission a new schedule of rates, joint rates, tolls, rentals, classification and charges for hot water heating, together with rules and regulations affecting same, including a temperature schedule for the outgoing water and a formula for determining the radiation requirements.

The radiation formula as given by the company is as follows:

$$R = d\left[75\left(\frac{W-G}{h}+G\right)+c\right]$$

Where W = exposed wall.
G = window and door opening, frame measurement.
C = cubic contents.
d = temperature constant.
h = wall constant.
R = radiation required.

Value of h = 1 for ⅞ in. wall.
2 for 2 in. wall.
3 for 4 in. wall.
5 for 6 to 9 in. wall.
7 for 9 to 13 in. wall.
8 for 13 to 27 in. wall.

Value of d
= 0.005 for 50° F. temp. difference.
0.006 for 55° F. " "
0.007 for 60° F. " "
0.0075 for 65° F. " "
0.0082 for 70° F. " "
0.009 for 75° F. " "

The above gives the rule for ideal conditions, requiring the minimum amount of heat for given cubic contents. To the radiation requirement thus calculated, there must be added a percentage to provide for exposed locations, bad construction, insufficient or improper repairs, and other conditions, which would make the minimum radiation requirement inadequate to keep the building comfortably warmed. These conditions, which cannot be ascertained by general rule, add from 5% to 25% above the minimum or ideal requirement.

In practice, where the extra requirement would be more than 15%, the owner is usually required to make the necessary repairs and changes, to bring the building within that extra percentage.

Rates for Direct Radiation.

Amount of Radiation Installed, Square Feet.	Rate per Square Foot of Radiation per Season in Cents.
0 to 500	20
500 to 2,000	18.88
2,000 to 5,000	17.77
5,000 or over	16.66

Forty per cent. of above rates added for indirect radiation.

A discount of 10% allowed if paid at the office of the company within ten days from date of bill.

REGULATIONS.

The regulations set forth in each contract are as follows:

The consumer agrees to equip and furnish the above-described premises with an interior system of radiation, consisting of radiators, pipes and other apparatus and appliances for hot water heating, extending to the outside basement wall of the building at a point designated by the company, if not already so equipped and extended, the arrangement and material of said system and the workmanship thereon to be approved by the company before any obligation on its part is incurred hereunder. All pipes and connections which are now, or may be, placed outside the basement wall of said premises shall remain the property of the company and subject to its exclusive control, and may be removed by it whenever this contract is terminated for any cause.

The consumer agrees that he will not in any manner change, divert or use the water circulating through said interior system and through said connections or permit the same to be so changed, diverted or used, and will exercise at all times reasonable care for the protection of the company's property on the premises and will not install any additional radiation in said premises without the written consent of the company endorsed hereon, and that the authorized agents and employees of the company shall have the right to enter at all reasonable hours upon the premises herein described for the purpose of inspecting said interior system and said connections; that he will at all times keep said interior system and the building in good repair and condition at his own expense, and the outside openings properly closed so as to exclude the outside air in cold weather; and it is expressly agreed that the company shall not be liable for any failure of circulation in said interior system nor for damage to person or property arising directly or indirectly from the furnishing of said heat on said premises or from defects in said interior system.

The heating season is from the 15th day of September to the 31st day of the following May. This contract shall expire on June 15th following the end of the heating season.

The consumer agrees to pay for the heating of said interior system the sum of .....dollars in equal monthly installments of ..... dollars, beginning.....19.....

This contract cannot be assigned or transferred by the consumer in any manner or form, but is exclusively made by the company, its successors and assigns, with the consumer himself.

The consumer agrees that he will prevent all persons other than the duly authorized representatives of the company from making use of the shut-off cocks of the heating connections outside of the building; that when the circulation is once established and the water turned on such service shall not be discontinued except by an authorized representative of the company; that the company may seal all drain valves between the heating system and the sewer; and in case drain valves or other valves are interfered with by any person such interference shall constitute a breach of this contract on the part of the consumer.

If the consumer shall fail to perform any condition of this contract on his part to be performed, or shall in any manner permit a breach hereof, the company may, at its option, terminate this contract without notice and without incurring any liability for damages occasioned thereby.

This contract is subject to all the rules and regulations of the company as now existing or as hereafter amended, and no promise, agreement or representation of any agent or employee of the company shall be valid unless incorporated in this contract.

Temperature Schedule.

The following outgoing water temperatures are given for various outside air temperatures:

Air Temp., Deg. F.	Water Temp., Deg. F.	Air Temp., Deg. F.	Water Temp., Deg. F.
80	80	20	178
79	81	19	179
78	82	18	181
77	83	17	183
76	84	16	184
75	85	15	185
74	86	14	186
73	87	13	188
72	88	12	189
71	89	11	191
70	91	10	192
69	94	9	193
68	97	8	195
67	100	7	197
66	103	6	199
65	106	5	200
64	109	4	202
63	112	3	203
62	114	2	205
61	116	1	207
60	118	0	208
59	120	—1	210
58	122	—2	211
57	124	—3	212
56	125	—4	213
55	126	—5	215
54	127	—6	216
53	129	—7	217
52	131	—8	218
51	133	—9	220
50	134	—10	222
49	136	—11	223
48	137	—12	224
47	139	—13	225
46	141	—14	226
45	142	—15	227
44	143	—16	228
43	145	—17	229
42	147	—18	231
41	149	—19	233
40	150	—20	234
39	151	—21	235
38	153	—22	236
37	155	—23	236
36	156	—24	236
35	158	—25	236
34	159	—26	236
33	161	—27	236
32	162	—28	236
31	164	—29	236
30	165	—30	236
29	166	—31	238
28	168	—32	238
27	169	—33	238
26	170	—34	238
25	172	—35	240
24	173	—36	240
23	175	—37	240
22	176	—38	240
21	177	—39	

Wind schedule No. 1 = 5° F. higher outgoing.

Wind schedule No. 2 = 10° F. higher outgoing.

New York State's New Factory Ventilation Law.

As already announced in these columns, the factory ventilation requirements in New York State will hereafter be determined by an Industrial Board which was recently created by action of the New York legislature. For the guidance of the board in the matter of factory ventilation the following general law on the subject was enacted April 3, 1913, and is listed as Chapter 196 of the laws of New York. It is entitled, "An act to amend the labor law, in relation to ventilation in factories and the removal of impurities and of excessive heat therein," and reads as follows:

Section 1. Section 86 of Chapter 36 of the laws of 1909, entitled, "An act relating to labor, constituting Chapter 31 of the consolidated laws," is hereby amended to read as follows:

Section 86. Ventilation. 1. The owner, agent, lessee of every factory shall provide, in each workroom thereof, proper and sufficient means of ventilation by natural or mechanical means or both, as may be necessary, and shall maintain proper and sufficient ventilation and proper degrees of temperature and humidity in every workroom thereof at all times during working hours.

2. If dust, gases, fumes, vapors, fibers or other impurities are generated or released in the course of the business carried on in any workroom of a factory, in quantities tending to injure the health of the operatives, the person operating the factory, whether as owner or lessee of the whole or of a part of the building in which the same

is situated, or otherwise, shall provide suction devices that shall remove said impurities from the workroom, at their point of origin where practicable, by means of proper hoods connected to conduits and exhaust fans of sufficient capacity to remove such impurities, and such fans shall be kept running constantly while such impurities are being generated or released. If, owing to the nature of the manufacturing process carried on in a factory workroom, excessive heat be created therein the person or persons operating the factory as aforesaid shall provide, maintain, use and operate such special means or appliances as may be required to reduce such excessive heat.

3. The industrial board shall have power to make rules and regulations for and fix standards of ventilation, temperature and humidity in factories and may prescribe the special means, if any, required for removing impurities or for reducing excessive heat, and the machinery, apparatus or appliances to be used for any of said purposes, and the construction, equipment, maintenance and operation thereof, in order to effectuate the purposes of this section.

The fourth paragraph of the law provides for fines for non-compliance with the orders of the industrial board. Failure to comply with such orders within 30 days incurs a penalty of $15.00 for each day during which such failure continues. Offenders are also liable to prosecution for a misdemeanor.

Paragraph 5 reads as follows:

5. When the commissioner of labor shall issue, or cause to be issued, an order specified in subdivision four hereof, he may in such order require plans and specifications to be filed for any machinery or apparatus to be provided or altered, pursuant to the requirements of such order. In such case, before providing, or making any change or alteration in any machinery or apparatus for any of the purposes specified in this section, the person upon whom such order is served shall file with the commissioner of labor plans and specifications therefor, and shall obtain the approval of such plans and specifications by the commissioner of labor before providing or making any change or alteration in any such machinery or apparatus.

Section 2. This act shall take effect October 1, 1913.

Pennsylvania Enacts Separate Contract Law.

Announcement is made that the separate contract bill, which was introduced in the Pennsylvania legislature through the activity of the Pennsylvania Association of Master Steam and Hot Water Fitters, has now become a law, the governor's signature having been affixed May 1. The full text of the new law is as follows:

An Act regulating the letting of certain contracts for the erection, construction and alteration of public buildings.

Section 1. Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania in General Assembly met and it is hereby enacted by the authority of the same, That hereafter in the preparation of specifications for the erection, construction and alteration of any public building when the entire cost of such work shall exceed $1,000 it shall be the duty of the architect, engineer or other person preparing such specifications to prepare separate specifications for the plumbing, heating, ventilating and electrical work, and it shall be the duty of the person or persons authorized to enter into contracts for the erection, construction or alteration of such public buildings to receive separate bids upon each of the said branches of work and to award the contract for the same to the lowest responsible bidder for each of said branches.

Section 2. All acts or parts of acts inconsistent herewith are hereby repealed.

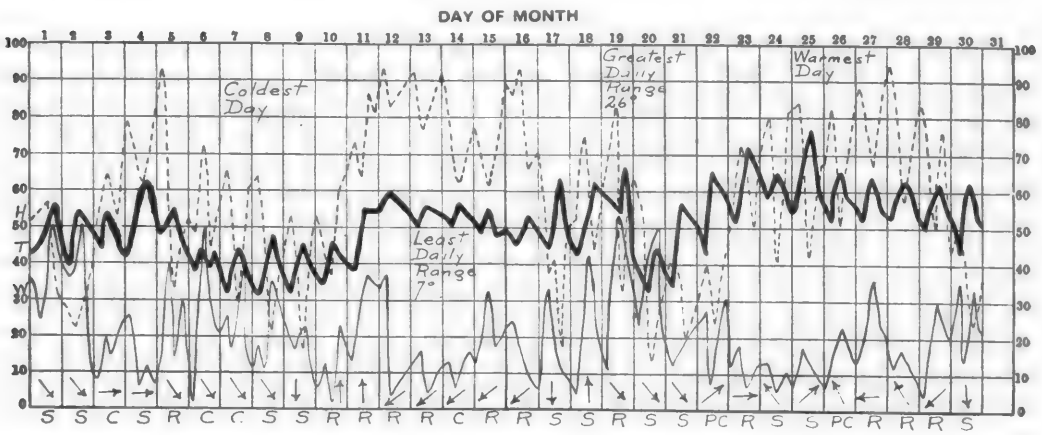
Bequest to Provide for Research Work in Ventilation.

A notable bequest has been made to the New York Association for Improving the Condition of the Poor by Mrs. Elizabeth Milbank Anderson, according to the terms of which $50,000 will be devoted to research work and experiments in connection with the general subject of ventilation and ventilating methods. This work will be carried on through a Department of Social Welfare established by Mrs. Anderson's bequest, and plans have been made to appoint a commission of six recognized experts to carry on the work.

Those who have received appointment as members of the commission are Prof. C.-E. A. Winslow, of the College of the City of New York, chairman; D. D. Kimball, heating and ventilating engineer, New York; Prof. F. S. Lee, College of Physicians and Surgeons, New York; Dr. James Alexander Miller, Bellevue Hospital, New York; Prof. E. B. Phelps, Massachusetts Institute of Technology, Boston; and Prof. Edward L. Thorndike, Teachers' College, Columbia University, New York.

The Weather for April, 1913

	New York.	Boston.	Pittsburgh.	Chicago.	St. Louis.
Highest temperature, degrees F	79	76	84	80	84
Date of highest temperature	25	25	25	23	17
Lowest temperature, degrees F	32	29	29	32	38
Date of lowest temperature	7	9	8	7	13
Greatest daily range, degrees F	26	29	33	29	30
Date of greatest daily range	19	19	22	17	21
Least daily range, degrees F	7	4	5	3	5
Date of least daily range	13	28	27	12	12
Mean temperature for month, degrees F	51	48	52	49	56
Normal mean temperature for month, degrees F	48	45.3	51	45.9	56.1
Total rainfall, inches	5.32	4.77	2.53	1.91	3.57
Total snowfall, inches	T	1.4	T	T	None
Normal precipitation, this month, in	3.30	3.55	2.9	2.88	3.52
Total wind movement, miles	13,715	7,750	9,370	10,239	7,882
Average hourly wind velocity	19	10.8	13	14.2	10.9
Prevailing direction of wind	N. W.	W.	N. W.	N.	N. E.
Number of clear days	9	13	12	13	17
Number of partly cloudy days	11	3	6	5	2
Number of cloudy days	10	14	12	12	11
Number of days on which rain fell	12	14	11	13	10
Number of days on which snow fell	..	2	..	..	..
Snow on ground at end of month, in	..	..	..	..	..


DAY OF MONTH
Coldest Day
Greatest Daily Range 26°
Warmest Day
Least Daily Range 7°
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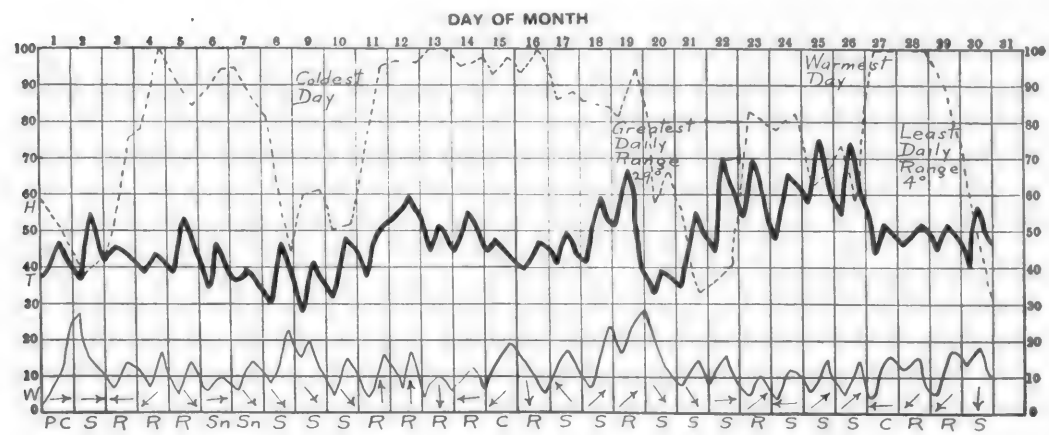
RECORD OF THE WEATHER IN NEW YORK FOR APRIL, 1913.

(Hourly Observations of the Relative Humidity are Recorded on This Chart.)


DAY OF MONTH
Coldest Day
Warmest Day
Greatest Daily Range 28°
Least Daily Range 4°
H
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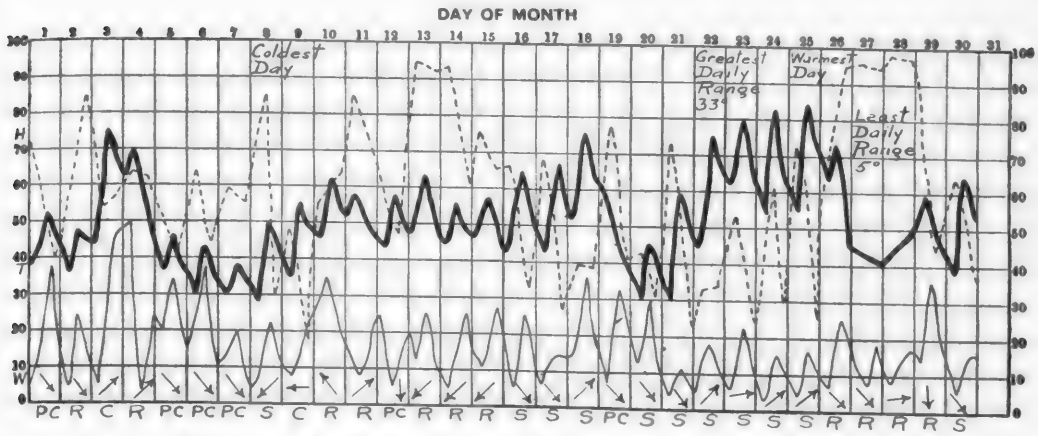
PC S R R R Sn Sn S S S R R R R C R S S R S S S R S S S C R R S

RECORD OF THE WEATHER IN BOSTON FOR APRIL, 1913.


DAY OF MONTH
Coldest Day
Greatest Daily Range 33°
Warmest Day
Least Daily Range 5°
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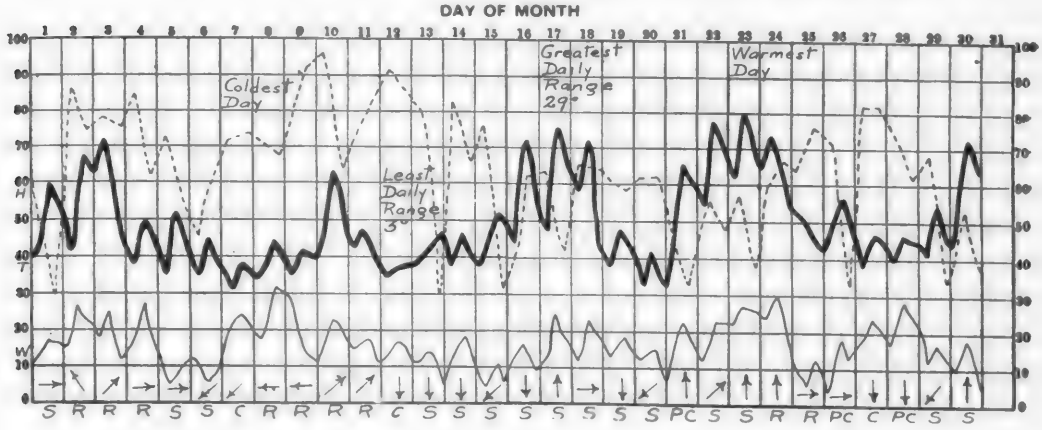
RECORD OF THE WEATHER IN PITTSBURG FOR APRIL, 1913.


DAY OF MONTH
Coldest Day
Greatest Daily Range 29°
Warmest Day
Least Daily Range 3°
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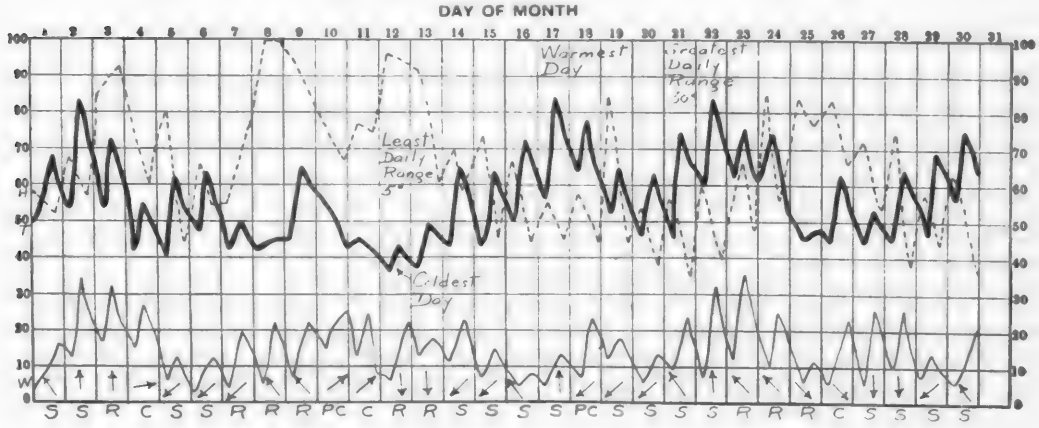
S R R R S S C R R R R C S S S S S S S S PC S S R R PC C PC S S

RECORD OF THE WEATHER IN CHICAGO FOR APRIL, 1913



RECORD OF THE WEATHER IN ST. LOUIS FOR APRIL, 1913.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing direction of wind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Date of Mid-Summer Meeting.

The mid-summer meeting of The American Society of Heating and Ventilating Engineers will be held at Buffalo, N. Y., July 17, 18 and 19, 1913. The headquarters will be at the Statler Hotel.

Dinner of the New York Heating Trade.

A "get-together" dinner for heating engineers in and about New York, held at the Engineers' Club, May 12, and marking the close of another year of activity on the part of the New York Chapter of the American Society of Heating and Ventilating Engineers, brought out the largest attendance that has characterized a local event of this kind. Nearly 150 members, friends and guests were present and the club's large dining hall, where the dinner was held through the courtesy of Frank T. Chapman, was taxed to its limit to provide the necessary seating accommodations.

Each guest as he took his seat found before him a folded blueprint containing the "specification of a mental feast which will accompany the dinner," etc., including a list of the speakers and the menu. This idea had been cleverly worked out by J. I. Lyle, who with Frank K. Chew and Frederick K. Davis, composed the dinner committee.

President Frank G. McCann of the New York Chapter welcomed the guests, declaring that the interests of the whole profession were advanced by such a gathering. He then gave place to Homer Addams, who acted as toastmaster. Mr. Addams qualified as a wit as well as a capable toastmaster in introducing the various speakers, his repartee with others at the speakers' table being hugely enjoyed by the diners.

The first speaker was C. R. Place, who told of the mammoth mechanical plant installed in the new Grand Central Terminal. From a mechanical standpoint, said Mr. Place, the buildings are upside down, having no basement, as the space corresponding to the basement is occupied by the tracks. The two track levels cover an area of 80 acres and it was necessary to carry the pipe tunnels underneath the tracks. In the early stages the question came up whether the entire 30 blocks covered should be separated into units or the whole considered as one large plant. The latter alternative was adopted and pipe subways were built forming a continuous loop 14 to 16 ft. wide and 7 ft. high. Through this tunnel, which is 1½ miles in extent, are carried heat, light and power to the buildings overhead. Direct current was adopted instead of alternating current, so as to correspond with the commercial Edison system.

The heating is done by hot water in a closed circuit, with expansion tanks at various elevations. The length of travel in the circuit is 7,000 ft. A total of 500,000 sq. ft. of radiation surface is now in operation, which does not include the Biltmore Hotel. This building is 350 ft. high, and on this account the heating system has been planned to operate under three pressures; high pressure from the 16th to the 28th floors, intermediate pressure from the 8th to the 16th floors and low pressure from the first to the 8th floors, each being treated as an individual system. The pressure on the upper floors will be 250 lbs.

The ventilating system has a capacity of 1,000,000 cu. ft. of air per minute, giving a 3-min. air change. The fans are of the Sirocco type, and are supplemented with air washers, equipped with humidity control. Tempered air only is furnished by this system.

John F. Hale, president of the American Society of Heating and Ventilating Engineers, was the next speaker. He recalled the fact that it was seven years since the Illinois Chapter was organized and spoke of the remarkable strides that had been made since that time in the development of the chapter idea. The chapters, he said, serve to bring the members together more frequently and in this way are a saving factor in filling the gaps between the society's meetings. He hoped to see a chapter started soon in Pennsylvania.

Frank G. McCann, who is mechanical engineer for the New York City Department of Education, as well as president of the New York Chapter, responded to the toast, "Industrial Education." He stated that 92 per cent. of the children in grammar schools do not graduate and that only 4 per cent. enter college. The apprentice is no longer with us in most lines of trade. Specialization of labor has become so marked and the economic push of progress so great that there is no longer a place for the apprentice. In building work, one gang does the roughing in, another gang the risers, and so on, so that a man working as a helper in putting up risers is given a license, but he has no all-round training. Most foremen know nothing of the allied trades. Some of the big manufacturing companies have started trade schools and have the students spend part of the time in the shop, part in the drafting room and part in the school room. The trouble with

this plan, said the speaker, is that the young men are caught too old.

As a result, vocational schools are coming into vogue. These schools take boys at an early age and turn them out as excellent material for finished mechanics. Mr. McCann emphasized the broad training of the vocational schools as their desirable feature.

The next toast was "Publicity," and was responded to by A. S. Armagnac. The speaker spoke of the practical difficulties in bringing the engineer and the public together, due to the fact that the public does not think or talk in engineering terms. Publicity, however, is being thrust upon the heating engineer through such bodies as the Ventilation Bureau in Chicago and through the action of Cleveland in appointing a city heating and ventilating engineer, while the recently-enacted law creating an industrial hygiene commission in New York State will give further publicity to the interests of the profession. The speaker said he looked forward to the time when every important municipality will have, in its building department, an official heating and ventilating engineer, which would mean a wider application of the art. This should mean co-operation and in such an organization as the New York Chapter is the channel for such co-operation to develop, bringing forth good fellowship as well as good practice.

Mr. Armagnac spoke of the present conditions in the trade, in which the dealings with other engineers were often marked by a spirit of criticism and "knocking." This spirit, he said, pervades the trade to an astonishing extent. With the added publicity that is coming to the heating engineer, it is of the highest importance that the profession should get together and show the public a harmonious and united profession as well as one that is alert and up-to-the-minute in its practice.

"The Kid in Engineering" was the toast assigned to George G. Schmidt. The speaker caught the fancy of the diners when he declared, "Don't tell us so many ways it won't work, but one way it will." He called attention to the fact that the young heating and ventilating engineer is not provided with opportunities for study in evening schools and he proposed that the chapter interest itself in the establishment of such a school.

The guest of the evening, Dr. M. W. Franklin, of Schenectady, was then introduced, being called upon to respond to the toast of "Purification." The speaker kept the diners in roars of laughter throughout an address that bristled with good stories and clever anecdotes, at the same time bringing forcibly to their attention the field for the use of ozone in heating and ventilating work. He declared that ozone had suffered much from its friends in their claiming too much for it. It has its place, he said, in connection with ventilating systems, but is not a universal panacea and should not be so considered.

Massachusetts Chapter.

Humidity was the subject of the last meeting for the season of the Massachusetts Chapter of the American Society of Heating and Ventilating Engineers. Those who took part in the discussion were W. C. Elliott, of the Stuart Cramer Co., W. W. MacLean of the Museum of Fine Arts, Charles F. Eveleth of the School House Commission, Boston, and Frank T. Chapman of the New York Chapter.

Mr. Elliott said that since the installation of the humidifying system in the Cheney Silk Mills there had been a notable freedom from all kinds of contagious diseases in this plant, especially the usual epidemic of grip, which heretofore had been a cause for anxiety every winter.

President Frank Irving Cooper made announcement of the ventilation commission which is to be appointed in New York, probably by Governor Sulzer, to make a special study of heating and ventilation of school houses, in accordance with a recent bequest made to the Society for Improving the Condition of the Poor in New York by the late Mrs. Elizabeth Millbank Anderson.

The chapter is planning to hold a special mid-summer outing, the date being left with the president. The regular chapter meetings will be omitted until Fall.

Illinois Chapter on the Status of the Heating Engineer.

The last meeting of the Illinois Chapter for the season was held at Vogelsang's Restaurant, Chicago, May 12. In discussing the status of the heating and ventilating engineer, which was the subject of the evening, the matter of free engineering was taken up. Mr. Widdicombe made the point that a distinction should be made between specialty men and manufacturers who draw plans to insure the correct installation of their apparatus, the heating engineer who prepares his plans with a view of getting the work, and the consulting engineer whose principal work is the preparation of plans. The opinion was expressed that free engineering was unavoidable under present conditions.

F. W. Powers spoke of the attitude of the architects as being largely responsible

for the practice of free engineering inasmuch as they usually favor those who save them the greatest amount of expense and effort in the carrying out of the work. As a result of the usual methods of architects in inviting bids, including plans and specifications, the most the successful heating engineer and contractor gets is the privilege of meeting the lowest bid submitted.

The matter of licensing consulting engineers and heating and ventilating contractors was also discussed, and this matter will, it is expected, be taken up at one of the chapter's Fall meetings.

A nominating committee was appointed by President J. M. Stannard, consisting of W. A. Cameron, W. B. Graves and William Lees.

Proposed Code Pertaining to Heating and Ventilating Installations.

Acting under resolutions passed by the National District Heating Association and the American Society of Heating and Ventilating Engineers, committees representing these two bodies met in Chicago March 21 for the purpose of working together on educational lines.

At this meeting the following resolution was adopted:

Resolved, That this committee formulate a basis for a code pertaining to important points in the installation of heating and ventilating plants, and said recommendation be submitted to the National District Heating Association, together with the suggestion that they cooperate with the American Institute of Architects, American Society of Heating and Ventilating Engineers and American Society of Mechanical Engineers.

In connection with the above resolution the committee representing the heating engineers' society, through Edmund F. Capron, vice-president, has submitted to the National District Heating Association a code of suggestions as follows:

CODE PERTAINING TO IMPORTANT POINTS IN THE INSTALLATION OF HEATING AND VENTILATING PLANTS, WITH SUGGESTIONS RELATIVE TO SAME.

1—Pressure, Velocity and Pipe Sizes. This would refer to supply by service companies, and to the pressure inside of the building which would be governed by the velocity of the steam. Pipe sizes refer to the sizes of heating mains and risers as well as to radiator connections inside of building and same should be made a basis for all heating plants installed, whether attached to central station heating or not. This also refers to high pressure work, expansion, water hammer, grading of lines and location of drips.

2—Radiation, Direct and Indirect. This would refer to the amount of radiation required to heat the building at certain temperatures inside and outside. It would also refer to bare risers, using same as radiating surface.

3—Division of Ownership and Responsibility. This would refer to the point at which the central station equipment was installed, also to the care and attention of apparatus inside of building. Having an established set of rules so that the heating contractor could work along definite and well defined lines, said rules to meet with the approval of the central station people.

4—Steam Traps With or Without Strainers. This would refer to style of trap recommended, suitable for the class of work and connected; also whether to use strainers on inlet connections.

5—Economy Coils. This would refer to the style and arrangement of same and also their capacity.

6—Insulation. This would refer to work underground on service mains, style, etc., also covering of pipes inside of building, giving the quality, thickness, etc.

7—Automatic Regulation. This, of course, would refer to the regulation of steam entering the building as well as regulating the various radiators.

8—Steam Meters, as to Sizes, Type, Efficiency, Reliability, Allowances for Errors and Definitions of Method of Installation. This subject would require full detail plans showing arrangement of connections to meters and recommending the various types acceptable to the central station company.

9—Weather Stripping. This would refer to the question of flat rates and how much reduction would be made in case the building was properly protected. With meter rates, the deduction in net cost would come to the owner.

10—Notice of Alterations. Would refer to changes in any of the heating lines, additional radiators, etc. All additions and alterations to follow as far as possible existing system in order to keep equipment uniform.

11—Seals on Meters and Traps. The installation should be protected for the central station company by sealing the valves on meters and traps in order that the owner could not change the amount of steam delivered.

12—Application of Patented Systems, Requirements and Restrictions. We believe the application of such systems would come under the jurisdiction of the central station company, and they should be required to pass on types of installations in order not to conflict with the operation of the plant. Only authorized workmen should install plants.

13—Testing of System. This would refer to testing of apparatus inside of building to see that the plant was operated properly and

that necessary changes were made by the owner as required.

14—TEMPERATURES INSIDE AND OUTSIDE. A standard temperature should be maintained throughout the country, and this matter should be taken up very carefully, temperatures to vary to suit conditions of various rooms: Dwellings, 70° F.; industrial plants (active labor), 60° F.; industrial plants (inactive labor), 65° F.

15—LOCKS ON SERVICE VALVES.

16—QUALITY OF MATERIAL AND GUARANTEE. This would refer to type of valve, quality of pipe, long radius fittings, etc., to make the apparatus high grade in every respect. Cooperating with architects, adopt a standard form of guarantee to meet requirements.

17—UNDERGROUND INSTALLATION. This would refer to any work inside of curb line where buildings are located some distance from the curb. This also refers to tunnel construction and involves the question of expansion, hangers, anchors, etc.

18—HUMIDITY. Referring to types of humidifiers, locations, degrees of humidity, etc.

Nos. 1, 2, 3, 6, 9, 10, 13, 14, 15, 17, would pertain to water as well as steam.

This report was on the programme for discussion at the recent meeting of the National District Heating Association.

Unique Heating and Cooling Equipment for a Factory Building.

Gustav Klein, managing director of the Bosch Magneto Co., of Stuttgart, Germany, while riding in an automobile between Holyoke and Springfield, Mass., said: "I cannot understand why the manufacturers in this country do not ventilate and cool all their factories. You have such excessively hot weather in summer."

America leads the world in the application of heating and ventilating plants, but there are other methods of ventilation not regularly employed in America, which undoubtedly give very satisfactory results and which possess some very attractive features. Such a plant is the cooling and ventilating equipment installed by the Bosch Magneto Company in their new factory at Springfield, Mass.

This company, which manufactures magnetos, spark plugs, etc., has its main works in Stuttgart, Germany. The growth of the automobile industry in this country made it imperative that they should have a local factory which was properly equipped to turn out the same high grade apparatus as that built by them abroad.

The building and its equipment were designed by German engineers from the firm's main works, Albert Klein and C. M. Wild. Mr. Frank Sutton, of New York, was the consulting engineer. His work was primarily that of seeing that the details of the plans and equipment fitted in with American made apparatus.

The building, as shown in the accompanying illustration, is 315 ft. long by 66 ft. wide, and has four stories, each story being 13½ ft. high.

The unique feature of the interior is the absence of any overhead heating or ventilating pipes or ducts. The heating is ac-

PLANT OF BOSCH MAGNETO CO., SPRINGFIELD, MASS.

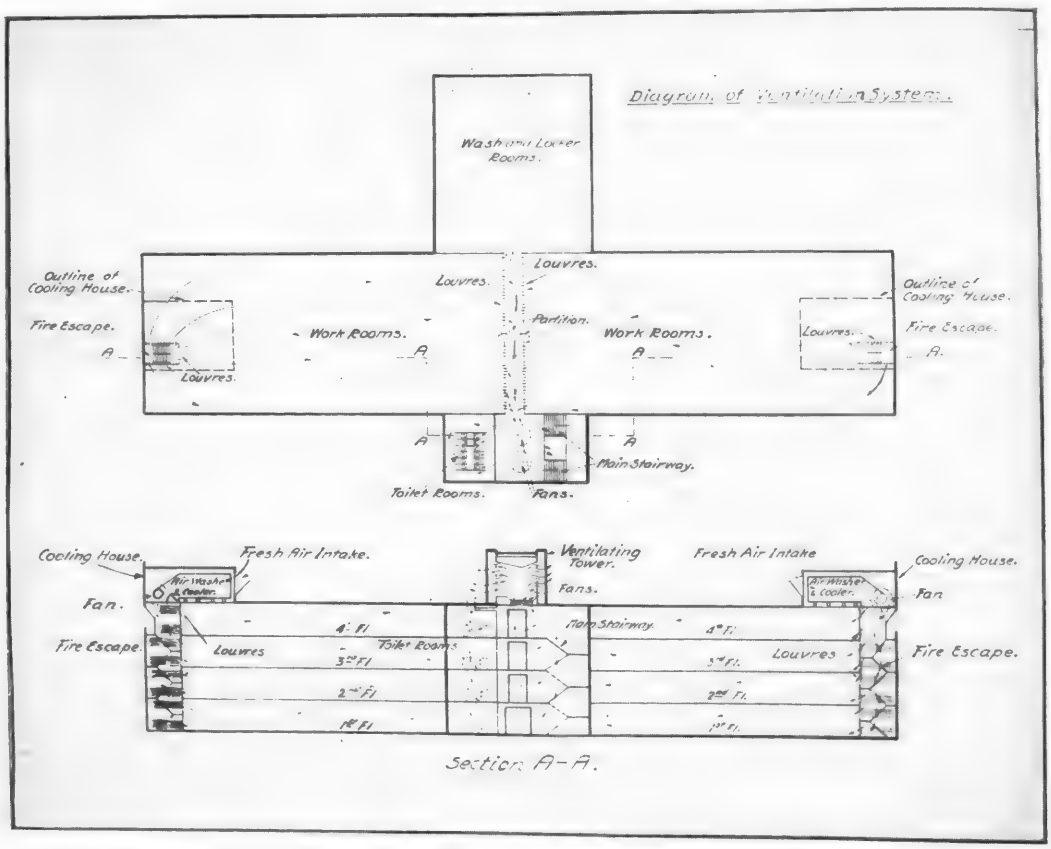
complished by radiators imported from Germany. These radiators are really cast-iron pipes arranged with radiating fins to increase the heating surface, and are placed along the walls below the window sills. Low pressure steam is used. These radiators are enclosed with a sheet-iron hood with an outlet opening above the radiators and an inlet at the floor line on the side toward the wall.

The cold air from the windows and walls drops down and enters the radiators from the bottom and rises up through the enclosed radiator. This current of air passing down between the casing and the wall prevents loss of heat through the walls by direct radiation, as would be the case were the radiators set directly against the walls.

The ventilation is accomplished by steel plate fans. The main central stair tower is used as an exhaust ventilating flue. Two vertical shaft dics fans, each having a capacity of 100,000 cu. ft. per minute, but which can be varied to exhaust from 25,000 to 100,000 cu. ft. of air per minute, are placed at the top of the main stair tower.

On the roof of the building at both north and south ends are located the fan houses in which are two large fans each having a capacity of 30,000 cu. ft. per minute. These draw the air from outdoors through two Carrier dehumidifiers and discharge the air downward through the fire escape stairways, at either end of the building, to the work rooms. The volume of air through the work rooms to the exhaust fans is regulated by louvres which are placed in the partition between the working rooms and the central corridors.

These corridors divide each floor into two parts, as shown by the illustration.



ARRANGEMENT OF VENTILATION SYSTEM FOR PLANT OF BOSCH MAGNETO CO., SPRINGFIELD, MASS.

It will be noticed that the ventilating louvres in the corridors are placed both in the top and bottom of the partition. By opening the bottom louvre and closing the upper set the foul air can be exhausted from near the floor of the workrooms in winter, and by opening the upper and closing the lower set the hot air from under the ceiling is removed in summer.

The operation of the ventilating system is flexible in that it can be varied according

to the weather conditions, as all the blower and exhaust fans are under variable speed control.

The Carrier dehumidifiers, of Carrier Air Conditioning Company make, are so designed that under cold or moderate weather conditions the centrifugal spray pump recirculates the spray water and the air in passing through the machine is reduced in temperature to that of the entering wet bulb. In hot weather water from an artesian well at a temperature of above 54° F. is used, and during such times the air is not only cooled, but dehumidified.

Although the air temperature outdoors may reach 95° F., the air leaving the dehumidifier very rarely exceeds 75° in temperature, after passing through the recirculated spray water, and can be cooled to 65° F. with the cold artesian well water. Thus it is possible to maintain temperatures in the work rooms from 5° to 15° below the outside temperature, with low humidities, producing a most refreshing atmosphere and adding materially to the efficiency of the operatives.

Doors are provided on the inlet of the dehumidifiers so they may be closed when the fans are shut down to prevent a natural upward draught from the stairway through the fans and out to the atmosphere.

The small centrifugal pump is used for recirculating the water in cool weather and the cold well water is delivered by the insulated pipe shown in illustration.

FAN AND AIR WASHER UNIT, PLANT OF BOSCH MAGNETO CO.

The Badger Self-Equalizing Expansion Joint.

A noteworthy device, which is especially designed to take care of irresistible strains in pipe lines caused by expansion and contraction, is the Badger self-equalizing expansion joint, which is made of corrugated copper, with external rings. This expansion joint is built to take up changes in length in pipe lines, whether such lines convey steam, water or air.

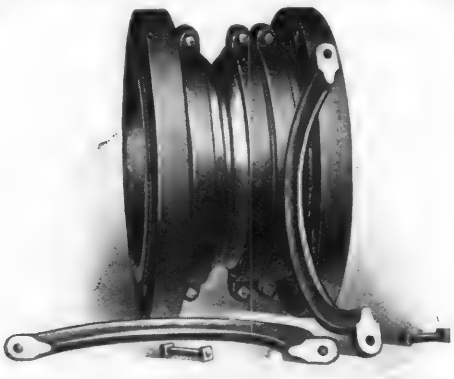
CORRIDOR, SHOWING VENTILATING LOUVRES, PLANT OF BOSCH MAGNETO CO.

The Badger joint, it is stated, combines the elasticity to stand repeated changes of shape with strength to resist any pressure for which the joint is designed. External rings on the corrugations distribute the strains among several corrugations, and by thus bringing many corrugations into service, no one of them is called upon to take more than its share of the work.

The number of corrugations depend upon the pressure and upon the length of the joint. For high pressure and superheated steam the change in length is considerable, therefore more corrugations are used. For very low pressures, as in exhaust piping, two or three corrugations are sufficient for the slight alteration in length. There are even some cases where the expansion is so little but vibration must be taken up that the joint does not need any external rings. But in most cases external rings are used both to add strength for high pressure and also to stiffen the exhaust pipe against collapse.

The Badger expansion joint, which is made by the E. B. Badger & Sons Co., 63-75 Pitts Street, Boston, is made in a complete line of sizes for all pressures and with flanges drilled to A. S. M. E. standards, both high pressure and extra heavy pressure. These joints require no packing and take up no more room than a pipe fitting.

For low pressure work they have been made up to 6 ft. in diameter and have been made

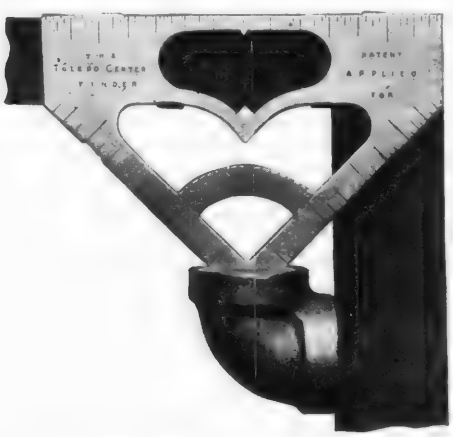


BADGER SELF-EQUALIZING EXPANSION JOINT.

oval, rectangular, circular and in special forms.

Toledo Center Finder.

A unique device for use in determining readily the center measurement of such fittings as elbows, tees, crosses (straight and reducing sizes, screwed or flanged) and covering a range of sizes from 1-in. to 6-in., is a new product of the Toledo Pipe



THE TOLEDO CENTER FINDER.

Threading Machine Co., Toledo, O. It is intended to be used on any steel carpenter square. Each straight edge is graduated, one edge in 16ths, one edge in 8ths and one edge in 4ths of an inch. The cross brace of the finder forms an arc of a true circle and serves as a protractor, being graduated down to 5°.

In addition to its basic use as a center finder, the device may be used for securing accurate measurements, striking correct angles and inclinations, in laying out piping. It is also designed for setting calipers or compasses to sizes within its capacity.

In using the device the finder is slipped over the narrow tine of the square. To find the center of a fitting, the fitting is held true against the wide tine of the square and pushed up against the finder which will slide one way or the other on the square until it seats itself on the fitting. The pointer on the finder will then show accurately the measurement desired. The device is listed at $1.

A Solderless Copper Ball Float.

A ball float made entirely of copper without the use of reinforcing material has lately been put on the market by the H. W. Johns-Manville Co., New York. No solder, red lead, rubber gaskets, or sheet steel are employed in its construction, either in joining the float proper or in attaching the brass spuds. The device is known as the J.-M. Dirigo solderless copper float. The hemispheres of the float are made of 12-oz. copper, flanged at the edges.

The flanges are folded over on each other, forming an air-tight double-locked seam. The spud, which is of solid brass, is fastened in place by a patented double-lock seam.

A damaged ball float, shown in the accompanying illustration, was one run over by a heavy truck. Although the wheel made a deep impression, tests made afterwards failed to show a single leak in the

J-M DIRIGO FLOAT SHOWING SOLDERLESS JOINT AND DOUBLE-LOCK SEAM FOR ATTACHING SPUD.

seam or at the spud. These devices are made in 4-in. and 5-in. round types and are heavy enough to open, and buoyant enough to close, any standard form of valve.

New Electric Car Heater.

One of the serious problems which have confronted railroad officials contemplating the electrification of certain portions of their systems has been the heating of cars. The Pennsylvania Railroad seems to have solved it with some degree of satisfaction by designing a new style of feed pump for use in connection with a steam heating apparatus. The pump is now being tried out, and so successful have the tests been that 12 more have been ordered built at the company's Altoona shops.

The apparatus for keeping coaches warm consists of an electrically-heated boiler of the flash type, a four-cylinder feed-pump and a water tank placed between the frames of the electric locomotive. When the steam reaches a certain temperature and a certain pressure the pump is automatically shut off and remains so until more water is required, when it is again cut in and supplies the necessary water for steam heat.

By equipping the electric locomotives with this outfit coaches can be kept at a proper temperature in winter weather.

Plans to Enlarge Cleveland's Municipal Heating Plant.

According to a resolution introduced in the Cleveland city council by Councilman E. M. Bieder, the way will be paved for the construction of a general municipal steam heating system in that city to cost $10,000,000. The resolution defines the territory to be covered by the new pipe extension from the Fairmount station and will enable the department to extend its steam pipes on Euclid Avenue and Cedar Avenue, S. E., as far westerly as East 89th Street and to a portion of East 88th Street. The Bieder resolution will be followed by an ordinance authorizing an expenditure of $50,000 to purchase necessary pipe equipment.

Novel Use of Vacuum Cleaning Machine.

Contractors frequently have trouble in fishing wires through fixtures and conduits where there are several bends. It requires a lot of workmen's time, as well as patience. I was talking to a contractor a few days ago and he was perplexed as to how to get two wires through a ⅜-in. gas pipe for a newel post light. The pipe had three 90° ells in it and was so located that it could not be disconnected, so I suggested that he send a vacuum cleaner on the job, which he did. We then took a long piece of string and made a ball of the string nearly as large as the opening in the pipe. Leaving the balance of the string attached we inserted the ball in one end of the pipe and put the smallest nozzle on the cleaner hose to the other end and sucked it through. The entire operation took about two minutes and of course after we had a string through the pipe we were able to draw the wires after it without any further trouble. By this method we did in less than five minutes what a man had already tried to do by hand for the best part of a whole day.—R. Homer Wood in *Electrical Merchandise.*

Trade Literature

Sprague Electric Products, including direct-current generators and switchboards, direct-current and alternating-current motors, and electric exhaust fan outfits are featured in a new catalogue of the Sprague Electric Works of the General Electric Co., New York. The catalogue gives, in addition, a list of the company's publications, covering the wide diversity of products explointed by this firm. Size 4x9 in. Pp. 24.

Automatic Electric Sewage Ejectors and bilge pumps are described in a new catalogue (Catalogue C) showing the full line of automatic electric bilge pumps and the Little Giant electric cellar drainer, made by the Chicago Pump Co., Chicago, Ill. The catalogue contains useful tables giving capacities, horse powers and discharge heads for the different types; also illustrated descriptions of their construction. A notable list of installation, accompanied by facsimile letters from users, testify to the quality of this line. Size 6x9 in. (standard). Pp. 24.

Pressed Radiators, made by the Pressed Metal Radiator Co., Pittsburg, Pa., is the title of a new catalogue, the first to be published since the reorganization of this company. The catalogue states that the company carries a large and complete stock of its various models in standard heights, both in sections and assembled, not only in its factory warehouse in Pittsburg, but also in New York, Chicago and Seattle. Special attention is directed to the company's line of wall or "suspended" radiators. In the Invincible type, for instance, the radiator is suspended from the side wall on adjustable concealed brackets, which add much to the neatness of its appearance. The Invincible type is also made in the standard form for steam or water, from 4 to 35 sections and from 14-in. to 38-in. in height. The catalogue contains full dimensions and other data regarding all types, together with telegraph code. Size, 4½ in. x 7 in. Pp. 42.

Ideal Heating Journal for April, 1913, the periodical of the American Radiator Co., Chicago, contains some interesting data on "The Efficiency of Pipe Covering," showing the results of tests made at the Institute of Thermal Research in Buffalo. The article is accompanied by a unique scale by which one may ascertain the additional load on a heating boiler when portions of the piping are covered and when bare.

United States Boilers, Capitol-Winchester type, made by the United States Radiator Corporation, Detroit, Mich., are discussed from base to smoke flue, each intermediate part being shown by clear photographic reproductions, in a catalogue devoted entirely to this type of heater. The Capitol-Winchester boiler is described as the first to be built with a rotary duplex grate, which consists of an outer ring section, having a slight pitch towards the center and rotating on steel ball bearings, and an inner section made of two parts, which, when in position, forms a basket-like center. The movement of the grate in shaking has the effect of slicing the fire nearest the effective heating surface of the firepot, moving the clinkers toward the center basket-like part of the grate. Size 4⅜x7¼ in. Pp. 18.

Graphite for the Boiler is an interesting booklet published by the Joseph Dixon Crucible Co., Jersey City, N. J., showing how Dixon's boiler graphite does its work. Directions are included showing how to feed the graphite to the boilers. Size, 3¼x6¼ in. Pp. 16.

Remedy for Water in Compressed Air is a new engineering leaflet (No. 14) issued by the Harrison Safety Boiler Works, 389 No. 17th street, Philadelphia, Pa. The suggestion of this leaflet is that Cochrane separators be installed in the air line to intercept the moisture. Separators used in this way, it is stated, are giving excellent satisfaction as air dryers.

Badger Quality Copper Boilers, metal sinks, hospital sterilizers, etc., are described in an attractive catalogue in colors, published by E. B. Badger & Sons Co., 65 Pitts Street, Boston, Mass. The text is profusely illustrated and is accompanied by full price lists. The catalogue contains convincing sales arguments for the use of copper boilers and metal sinks.

Bristol Counters, for automatically counting and registering revolutions or strokes, etc., are shown in a new bulletin published by the makers, the Bristol Co., Waterbury, Conn. Special attention is called to the new Bristol set-back counter which can be quickly and easily set back to zero position with one turn of the key applied to the slotted post. The company has been given a patent on this device, which is particularly valuable where resetting is necessary.

Monash Noiseless System of Vacuum Heating, sold by the Monash-Younker Co., Chicago, is featured in a new circular giving views of a variety of important buildings in which the system is installed, showing its wide adaptability. Special attention is called to the elimination of noise from the heating plant with this system. Another descriptive circular, issued by this company, contains a partial list of plants equipped with the Monash noiseless system of vacuum heating, numbering over 180.

Leiman Bros. Rotary Positive Vacuum Pumps, made by Leiman Bros., 62 John Street, New York, are the subject of an unusually interesting catalogue, amounting to a treatise on the use of this pump, especially for vacuum cleaning work. The catalogue gives the results of much practical experience and will be found more than useful to those engaged in laying out vacuum work. Size 5x8 in. Pp. 24.

Triumph Packless Radiator Valve, having the "four-in-one" feature which consists of a ground metal joint, a packless joint, a leakless joint and a self-grinding joint, is shown in newly-issued circular matter from the Triumph Valve Co., Mansfield, O., the company's New York office being located at 121 West 42d Street.

Bristol's Class III Recording Thermometers and Bristol's Recording Differential Pressure Gauges (Bulletins 143 and 173) are new catalogues recently published by the Bristol Co., Waterbury, Conn. In the catalogue on recording thermometers the company's line is presented exhaustively, with views showing the interior construction for high and low ranges, methods of application, list and specimen sections of charts and other valuable data. Size 8x10½ in. Pp. 48 (punched for binding).

Webster System of Air Conditioning is the subject of a handsome picture folder, recently sent out by Warren Webster & Co., Camden, N. J., illustrating the Webster air conditioning department and its products. The illustrations include some twenty photographic reproductions presenting, in comprehensive detail, the construction and operation of the company's air conditioning apparatus. Views of the main plant and interior views of the offices show the company's present capacity and facilities which have already enabled it to attain a record of 7,000 vacuum and modulation steam heating installations, 6,000 installations of Star vacuum feed water heaters

and chemical purifiers and 10,000 installations of steam and oil separators.

39,000,000,000 Skeletons to the Cubic Inch Filled with Dead Air is the striking title of a carefully-prepared circular recently issued by the Armstrong Cork Co., Pittsburgh, Pa. The circular is devoted to an unusually readable description of the Nonpareil high pressure covering for steam lines and boilers, which has as its principal ingredient diatomaceous earth. This material, as stated in the heading, is composed of the skeletons of microscopic plants that grew in the sea ages ago. A feature of the covering is that it will stand repeated wetting and drying without injury. One of the views shown is the underground steam line of the Merchants' Heat & Light Co., in Indianapolis, this company having in use no less than 1900 ft. of 30-in., 3000 ft. of 20-in. and 800 ft. of 10-in. Nonpareil covering.

New Type of Automatic Ventilator.

An automobile ventilator, designed for use in any space devoted to the admission of fresh air, has been invented by Alex. Fletcher of Wharton, Ont., and will be marketed by Bert Fletcher, Ripley, Mich. The ventilator is equipped with vanes, similar to wooden window shutters, which are hung on springs and close under wind pressure. This makes it impossible for high winds to force rain, snow or dust into a room. When several ventilators are in place in an apartment, the shutters on the windward side will close, leaving those on the leeward side open. The vanes are provided with felt strips to deaden sound, which also act in preventing the admission of dust. A screen attachment is also provided as a protection against flies.

An idea of the wide adaptability of the Patterson hot water tank may be gained from the notable list of installations recently made by the manufacturers, Frank L. Patterson & Co., 26 Cortlandt Street, New York.

Syracuse City Hospital, Syracuse, N. Y.; The Sevilla Hotel, New York; Kensington Hospital, Philadelphia, Pa.; Pendemins Hotel, Edmonton, Alta.; Black Fireproof Building, Los Angeles, Cal.; Raymore Apartments, New York; Y. W. C. A. Building, Yonkers, N. Y.; Martin Restaurant, New York; Yadkin Hotel, Salisbury, N. C.; St. Joseph's Seminary, Dunwoodie, N. Y.; The Bismarck Restaurant, Cleveland, O.; Harmer Rubber Reclaiming Co., East Millstone, N. J.; Kings County Hospital, Brooklyn, N. Y.; White Sulphur Springs Hotel, White Sulphur Springs, W. Va.; Potter Knitting Co., Springfield, Mass.; Broadway Market, Detroit, Mich.; Bureau of Printing and Engraving, Washington, D. C.; Winecoff Hotel, Atlanta, Ga.; Celburen Apartments, New York; New Century Hotel, Dawson Springs, Ky.; Magnus Hotel, Cedar Rapids, Iowa; Barnard Court Apartments, New York; Fiat Automobile Plant, Poughkeepsie, N. Y.

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* Every other month.

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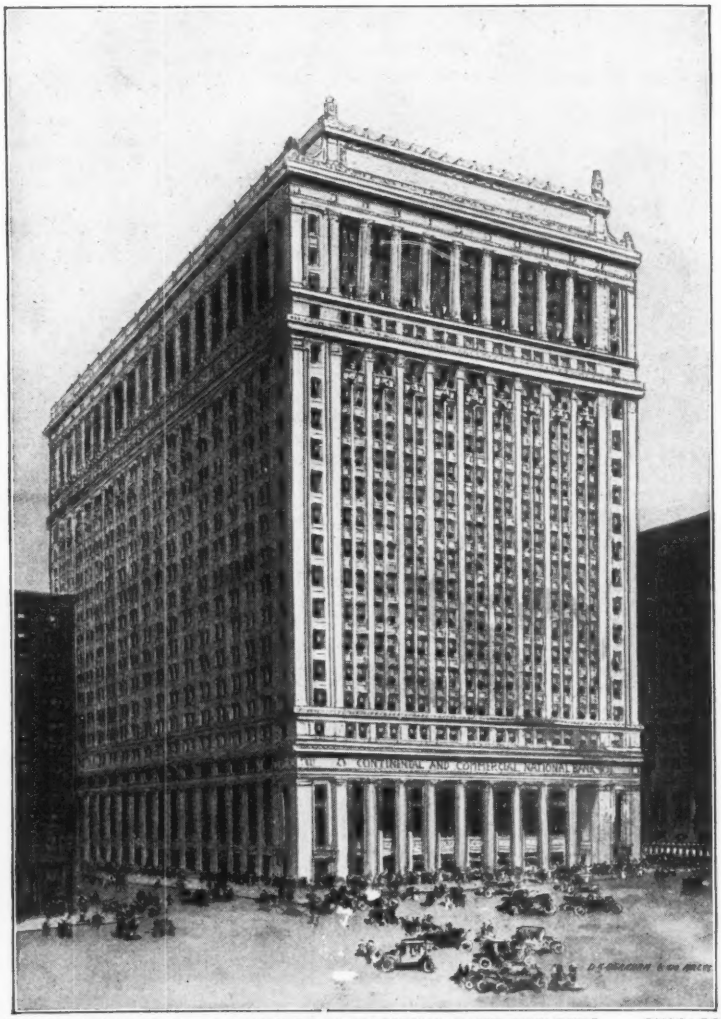

THE CONTINENTAL and COMMERCIAL NATIONAL BANK BUILDING CHICAGO
Hanley Casey Co., Heating and Ventilating Contractors, Chicago

D. H. BURNHAM & CO., Architects, Chicago, through their Board of Consulting Engineers and the Investigating Committee appointed by the Bank, adopted the MONASH NOISELESS SYSTEM of VACUUM HEATING for the CONTINENTAL & COMMERCIAL NATIONAL BANK BUILDING, which covers an entire city block, the largest building of its type under one roof in the world.

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